THE

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THE

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## THE ELECTRICAL RESISTANCE OF ALLOYS.

THE behaviour of pure metals and alloys as regards their electrical resistance at low temperatures has been established by the researches of Profs. Dewar and Fleming. It is now well known that in the case of pure metals there are indications that resistance would vanish at absolute zero of temperature, and that in the case of alloys this diminution would follow quite a different law. The question is discussed by Lord Rayleigh in a short article in *Nature*, June 18th, 1896, where he suggests that thermo-electric effects may possibly explain the behaviour of alloys. We are to imagine a conductor composed of two simple metals, arranged in alternate laminæ perpendicular to the direction of the current. According to the discovery of Peltier, when an electric current traverses such laminæ there is either development or absorption of heat at the junctions. Lord Rayleigh then explains that "the temperature disturbance thus arising increases until the conduction of heat through the laminæ balances the Peltier effects at the junctions, and it gives rise to a thermo-electric force opposing the passage of the current." We are next to assume that the back E.M.F. is proportional to the direct current, and therefore that it has the same effect as true resistance. He gives an expression for this pseudo resistance in terms of the thermo-electric force of the couple, the conductivities for heat of the two metals, and the proportional amounts by volume in which the two metals are associated in the alloy. It is an expression independent of the number of laminæ; "the number of couples which co-operate is indeed increased by finer lamination, but the efficiency of each is decreased in the same proportion by the readier conduction of heat between the junctions."

Mr. Saville Shaw, in *Nature*, August 11th, 1898, returns to the problem, and considers it in the aspect of the micro-structure of alloys, giving a very beautiful illustration of laminæ observed in a silver-lead eutectic. We may remind our readers that an "eutectic" is the part of a molten mixture of metals that is the last to solidify; it corresponds to the "mother liquor" in the case of crystalisation from solutions. When a plumber is making a "wiped joint," small portions of the solder first solidify, or are "liquated" out, and there is left the "eutectic," which remains molten long enough for him to finish the operation. Prof. Roberts-Austen treated of "eutectics" in his last Cantor lectures.

The delicate crystalline appearance of the sections of eutectics photographed by Mr. Saville Shaw helps us to realise the nature of the laminæ concerned in Lord Rayleigh's theory, but it is not necessary to limit our ideas as to the size of the laminæ to the dimensions of the markings seen in these sections. The theory makes no restrictions as to their fineness, so that we may imagine them, if necessary, to be of molecular dimensions. This extreme fineness of the transverse laminæ, and the close packing of the couples, assists us to account for the rapidity with which the

various electrical and thermal actions operate when starting, stopping, or reversing the current. But even with this assumption, it is not quite evident why the Peltier effect should begin to act so suddenly, continue so steadily, and cease so abruptly with the current—in other words, why the resistance of the alloy should be constant, at a given temperature, if it depends even partly on a Peltier effect. A very interesting case to consider would be the resistance of an alloy at the neutral temperature of the constituent pair of metals. At this temperature the metals are thermo-electrically identical, and the Peltier effect vanishes. The corresponding resistance should be the *true* resistance at that temperature. The reversal that occurs at the neutral temperature may be associated with the curious behaviour of alloys having negative temperature coefficients.

Mr. Saville Shaw's photographs represent the section of an alloy of lead with 2·8 per cent. of silver, the texture of which is intensified by etching with acetic acid. He has also succeeded in separating some of the bright silver laminæ. They are extremely thin, and transmit a greyish violet light. He considers that the processes of rolling and wire drawing would not entirely destroy this laminated structure, and that its existence would almost certainly result in thermo-electric effects, such as those required on Lord Rayleigh's suggested theory. This is positive evidence of the greatest value, and we hope it will stimulate physicists to a further discussion of the matter. Experiment is very much hampered by the various thermal conductions that complicate the electrical actions within the wires, and also by the many forms in which metal exists in alloys. Prof. Roberts-Austen mentions at least four eutectics for copper-zinc, and six for copper-tin. Let us then suppose a copper-zinc-tin alloy to be formed into a wire; it would consist of at least ten eutectics, intermixed with scattered proportions of metals liquated at different temperatures. This mass has further to be complicated by hammering, rolling, annealing, and wire-drawing. When we remember that the Peltier coefficient varies with every touch and turn of the metals forming the couples, it is indeed difficult to explain the constancy of the electrical qualities of the alloys of which standard resistances are made, if it is the Peltier effect that governs their conductance.

## THE RELATIONS BETWEEN PURCHASER, ENGINEER AND CONTRACTOR.

Apropos of this subject, Mr. W. H. Bryan, in a paper recently presented to the American Society of Mechanical Engineers, takes up a position in favour of the engineer rather than of the contractor. He argues somewhat against the view that contractors should be allowed to supply standard goods, on the ground that a too rigid standardising is apt to hinder progress. Some manufacturers are slow to adapt their designs and patterns to advanced and improved practice, and an engineer is justified in calling for the latest ideas to be embodied in his schemes. An engineer does not always get credit for what he does in this respect. In a recent case which came before the Law Courts, the payment of an engineer's fee was disputed, the chief ground being that he had specified for an 8 feet diameter Lancashire boiler, instead of for one of 7 feet, like the pre-existing boiler about 30, if not 35, years old. There are some persons whose object is to obtain an engineer's services for nothing, and no doubt many engineers have experienced the ingratitude of clients in whose interests they have done treble the work they need have done, only to find that the result has been to give an opportunity to dispute payments.

The rapid changes in electrical engineering are Mr. Bryan's reasons for objecting to a too hard and fast rule of standards. Standard apparatus is only possible, of course, when we are assured of a fairly constant demand and reasonable permanence of type. But are changes now so rapid that we cannot assume a reasonable permanence of type? Advance in electrical machinery will not be so speedy now that the more experimental stages are past. In 1860, or thereabouts, the Lancashire boiler had a diameter of 7 feet. To-day it is only 8 feet, though there are larger sizes. Nearly 40 years have been occupied in gaining a foot of diameter, and though in the same period pressures have increased, this has been met by mere additions to plate thickness, superior detail in rivetting, and stronger materials with better tools and workmanship. But there has never been a time when the standard boiler could not have been asked for and obtained, and in a settled industry types change slowly, and standards are allowed to exist several years before any startling advance is made. Obviously, as Mr. Bryan says, the unscrupulous contractor must be guarded against. But is it not often impossible to get good work at the price of the lowest tender, and is it fair to an engineer to put him in the position of demanding something which is ostensibly offered at less than cost price. We think not. Nor is it fair to honest contractors to accept the lowest tender when this is obviously incorrectly estimated.

The subject is one of great difficulty. It is perfectly clear that an engineer should protect his client against overcharges such as must inevitably result from a demand for the very latest improvements unless his client is willing to incur the expense. It is equally clear that the lowest tender must not be accepted if this implies the use of so-called standard appliances which are really out of date. We do not desire to regard the contractor as superhonest, but it is necessary to realise that a contractor's aim is to make money, and the engineer who accepts a tender which cannot be carried out at a profit ought to be careful. It may pay to tender at a loss in order to work off materials which have, perhaps, just been thrown on a contractor's hands, and it would be only vexatious to prevent such a low tender being accepted. At the same time, abnormally low tenders are suspicious, if not dangerous. We know that when contractors are really doing good work, some engineers make trouble for the sake of doing so, much as policemen make cases so as to appear to be doing their duty. Clients are as often to blame for trouble as are contractors. We have previously stated in these columns that we look upon the duty of an engineer as obtaining for his client the best possible results for a given sum, not to produce elaborate plans and specifications for articles that can be purchased like tintacks.

It is often to the unreasonable and ignorant expectations of clients that such useless documents are prepared. They engage engineers, and having done so, perpetually interfere and meddle with what they do not understand. They listen to all kinds of extravagant tales from other interested persons, and burden themselves with many extra expenses, which they endeavour to lay upon the engineer. Limited companies, with uninformed non-technical directorates, are apt to be great offenders. Because they cannot understand things, they suspect every evil, and incur losses for shareholders, whose interests they are supposed to safeguard.

## OZONE: ITS PRODUCTION AND APPLICATIONS.

Since Du Moncel produced ozone some 40 years ago, by passing an electric current from a Rhumkorff coil through a condenser composed of two metallic plates separated from each other by a sheet of glass, it has been generally admitted that high tension currents should be employed in the production of this remarkable gas. The discovery of the "step-up" transformer has now made it possible to develop from this mere laboratory experiment an economical method of producing ozone on an industrial scale. No one has done more in this direction than Mr. E. Andreoli, whose patents appear to cover almost every conceivable application. The difficulties of using ozone in technical operations have been enormous, but they have mostly disappeared before the tenacity and ingenuity which Mr. Andreoli and his sons have brought to bear upon those practical problems which have baffled so many others.

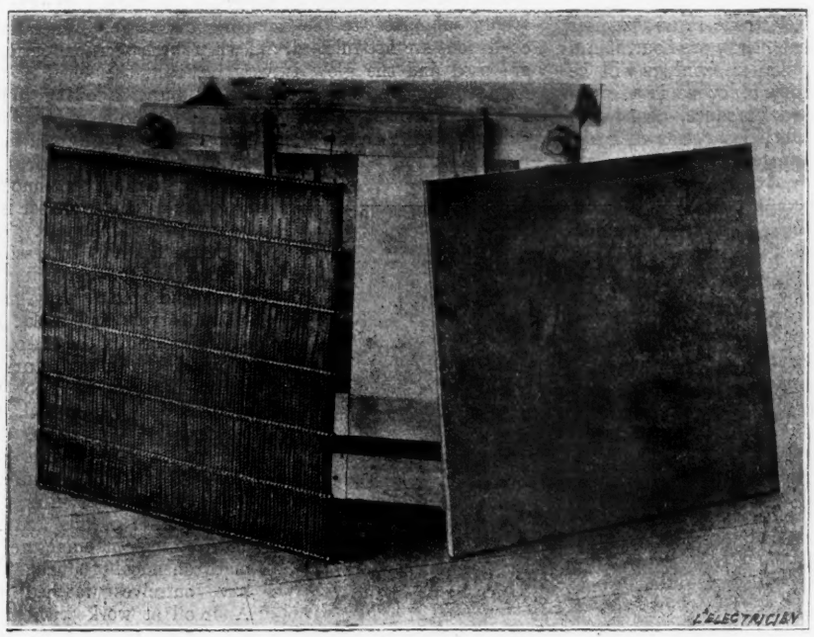


Fig. 1.—The Parts of an Element or Oxoniser.

A grid with a glass sheet behind which is intended to separate it from a flat electrode. It is placed against a wooden frame, which is coated with an insulating material, and which serves to keep the dielectric plates and electrodes together. Next to this is a flat electrode.

The most formidable obstacle to be surmounted in producing large quantities of ozone from the atmosphere is the heat of the discharge which has the effect of "uncondensing," as it were, the ozone into ordinary oxygen. Besides this, when the temperature rises the glass which is used to separate the metallic electrodes gradually loses its dielectric property, and even becomes a conductor of electricity. The current soon passes through the glass, which cracks, and the apparatus then ceases to work. These difficulties were pointed out long ago by Hautefeuille and Chappuis, two industrious workers in this field of research. The silent electric discharge causes a considerable rise of temperature, and it is conceivable that its luminous waves being continually emitted from the electrodes upon the surface of the glass dielectric eventually cause disastrous results, reducing the yield of ozone to an insignificant amount.

Exhaustive experiments have proved that the chief cause of the heat generated in an ozoniser is the density of the current being too great. Flat electrodes have been tried, but with a current which would be sufficiently large for a point-bearing electrode facing a flat plate, they give neither glow nor ozone. Flat electrodes require a denser current than point-bearing grids, and this means the production of heat. It has therefore been found preferable to use electrodes provided with numerous points, which on both sides of a dielectric are set to work, points against points, or points against flat surfaces.

There is more to be said than one would think about the influence of points in the production of ozone. It is obvious that the "electric effluvia," as Hauksbee called it, will flow out better and more powerfully from a multitude of points than from a flat plate on which the tension is uniform. More ozone is formed at angles or points than on flat surfaces, plain tubes, &c. It is at the top of a cone that the electric density has its greatest value, and electricity accumulates there so abundantly when the point is very sharp, that in spite of its insulating properties the air is electrified, repelled, and replaced by a fresh amount of air, which is in its turn electrified, and so on. Points have not, as Franklin thought, the power to attract the electric fluid, but they have the property of liberating and discharging with the greatest rapidity the electricity with which they are charged.

The conclusion to be drawn is that with point-bearing grid-like electrodes, small electric currents are available for the production of ozone without any injurious rise of temperature.

The generators constructed by the Electric Ozone Syndicate, working Mr. Andreoli's patents, are used in such a way that the formation of detrimental heat is prevented. The surface of the electrodes and of the dielectric is considerable, the speed at which the air is forced through the apparatus is great, and the glow of the silent electric discharge is reduced to a minimum. Thus the glow being feeble and hardly visible, its calorific power is insignificant, and there is no formation of nitrous compounds, which can only be produced by powerful "effluvia" due to a very high electrostatic tension.

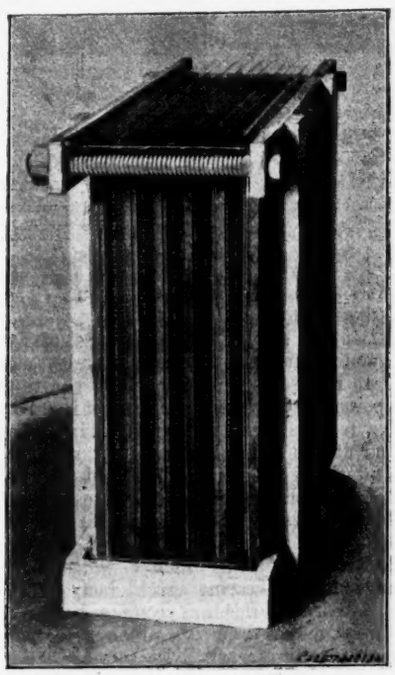


Fig. 2.—A Unit Oxoniser containing 80 square feet of Electrodes.

D

The commercial ozonisers of the Electric Ozone Syndicate are extremely interesting from an industrial point of view. They consist of grids formed of serrated wires of aluminium and of flat aluminium plates. These are kept separated by sheets of glass, and the whole of the plates and grids are held together by wooden clamps. Their construction is very simple. There cannot be any uncertainty or disappointment about the regular production of ozone however large the installation may be, since, if a given quantity of ozone is produced by a given surface of electrode in an ozoniser with a given expenditure of electrical energy per hour, it can be calculated accurately how many similar ozonisers will be required to obtain a desired quantity of ozone in a given time. These commercial ozonisers produce about 125 grammes of ozone per kilowatt. Until last year, when Mr. Andreoli greatly improved his apparatus, the output was

Fig. 3.—A Half-kilowatt Ozone Battery.

Contains eight sets of electrode units grouped in parallel and worked by a Crompton transformer. When the current is 0·75 watt per square foot of electrode, the yield is 60 grammes of ozone, or 120 grammes per kilowatt; 85 volts 6 amperes in the primary circuit; 2,800 volts 0·13 ampere in the secondary circuit.

30 grammes of ozone per horse-power-hour. The cost is 2d. per 1,000 watt-hours.

An element or unit of ozoniser is a set of five grids, six glass separators, and six flat plates suitably mounted in a frame. It represents a surface of 80 square feet. The average power of current per square foot is 0·75 watt. The most advantageous conditions of obtaining a good yield of ozone, and at the same time for safely working the ozone generator during a long run, are fulfilled when the current absorbed for the electrification does not exceed 0·75 watt per square foot of electrode. At this rate 60 watts are required per set of 80 square feet electrodes.

The electrodes of the ozoniser which has just been described are point-bearing grids facing flat electrodes. The point-bearing grids are composed of a number of serrated wires, mounted on rods running through them and kept separated by washers. In some cases, instead of a point-bearing grid facing a flat aluminium plate, two point-bearing grids are used for producing ozone.

A good yield of ozone is obtained by observing the following principles: The current in the primary circuit, and the tension in the secondary, must be as low as possible, and the active area of the ozone generator must be very large. The greater the speed of the air passing between the points of the grids and the flat plates the better the yield of ozone. For commercial purposes it is much more advantageous to have a large mass of diluted ozone than the same quantity of ozone in a small volume of air. The feebler the glow the less the temperature rises, and if there be a slight generation of heat the strong draught of the air which passes compensates it. The air must be evenly distributed through all the elements of an ozone installation, so as to be evenly submitted to the ozonising discharge. When these conditions are not fulfilled, *i.e.*, when high tension currents are used and the glow is very brilliant, the smell of the ozonised air is strong and somewhat pungent owing to the formation of nitrous compounds, and less ozone is produced.

The *rôle* of ozone in industrial operations is destined to be very great, and whenever powerful oxidation is required at low cost, acting continuously and rapidly the ozoniser may be used with advantage.

Ozone has been successfully applied to the maturing of wines and spirits, the sterilisation of vats and casks, the oxidation of oils, the seasoning of wood, the manufacture of artificial perfumes; to the treatment of spent oil, the bleaching of textiles, the purification of starch and dextrine, the manufacture of vinegar, the bleaching and deodorisation of oils and fat, and to the manufacture of many chemical products. We have ourselves watched Mr. Andreoli at work with many substances which have been sent to him for experimental treatment, and have been surprised to see the wonderful results which he obtains. The other day when we were present, there were some experts from Holland testing for themselves the efficacy of ozone in the purification of water. Judging from the favourable reports which have been received from medical men, we should suppose that the use of ozone will soon become general in the treatment of disease, for excellent results have been obtained in the treatment of anæmia, whooping cough, malaria, tuberculosis, wounds, ulcers, &c. The Electric Ozone Syndicate makes some very ingenious and cheap inhalers, &c., for the use of patients for whom the application of ozone has been prescribed.

Amongst other useful applications is the use of the ozoniser in the purification of the air in hospital wards, and in places where the atmosphere is vitiated by the congregation of many people. Ventilation, too, can be obtained either with a current of ozonised air circulating in a continuous manner, or by forcing it through rooms at intervals in the day-time or night.

No one can say that the various forms of apparatus which are now being made under Mr. Andreoli's patents are mere laboratory playthings. They are, on the contrary, practical apparatus, capable of being installed under conditions of wear and tear, and of doing their part efficiently without breaking down in any industrial operations for which they may have been devised.

Although ozone is not a new thing, there is a great deal of inertia in those trades in which ozone could be most useful. This inertia, however, is being overcome, and the reluctance of manufacturers is disappearing, for Mr. Andreoli can demonstrate practically anything he claims that his apparatus can do. We believe ourselves that there is a great future for the Andreoli ozonisers.

## HOW TO DESIGN A DYNAMO.*

The reader who carefully peruses the following set of lessons must not expect to emerge from his study a perfected dynamo designer. All that is expected and hoped for is to give the student an idea of what must be taken into consideration in designing a machine, and possibly to assist him in making moderately successful small bi-polar designs.

The formulæ and other data, by the aid of which the dimensions of a direct current machine are determined, are of a varying character. Some are magnetic, some electrical, and some mechanical, and of all of these some are rational, that is, deduced from scientific laws, and others are empirical, that is to say, they are modelled to fit the facts as they are experimentally found, and are the result of practical experience. Almost every designer has his own ideas as to the best empirical formulæ. By far the best way to understand how to design a machine is to follow through the methods employed in designing an actual machine taken for an example.

To this end we will assume that we are designing a 100-light dynamo of the high speed, belted, drum armature type. The machine is to be of the simple horseshoe form, with the armature uppermost. It is to operate at 110 volts, and is to have a margin for compounding. The compounding is to be 10 volts. The prescribed speed of the dynamo is to be 1,500 revolutions per minute. These are all ordinary commercial conditions, and very easy to fulfil.

The first step is to calculate the total current output of the dynamo. An ordinary incandescent lamp takes an average of ½ ampere, and the machine will therefore have a total output current of 50 amperes, which must be available for the outside circuit. In addition to that we must have some current for the purpose of exciting the fields. In such machines as this it is found that the fields can be excited with about 6 per cent. of the total output of the dynamo, that is to say, 3 amperes in this case, making the total available current 53 amperes. If, therefore, we calculate a wire for a machine which can deliver 55 amperes, we shall have an ample margin.

The machine is to be of the bi-polar type, and consequently there are two circuits in the armature, each of which must carry half the total current, viz., 27½ amperes. The first question therefore arises, how much must this wire be to carry the current without heating? In this case we must resort to practical considerations and note just what has been the results with other armatures. A single wire freely suspended in mid-air will carry much more current than if tightly wound into a bobbin. The following table, which has been prepared by a prominent designer, is a very safe criterion by which to go :—

| | Amperes per square inch. |
|---|---|
| Small high-speed armatures ... ... | ... 2,500 to 3,500 |
| Large „ „ ... ... | ... 1,500 „ 2,500 |
| Small low-speed armatures ... ... | ... 1,500 „ 2,000 |
| Large „ „ ... ... | ... 1,100 „ 1,600 |

However, heating is not the only consideration. We want an armature of low resistance, because there will be less drop in such an armature and the regulation will be better. Therefore these figures represent the limits to which we may go, and not necessarily the wire we shall choose. Consulting the table, we see that, as that is a small high-speed armature we may safely assume a current density of 2,500 amperes per square inch. If we are to deeply notch this armature with teeth, and thereby bury the conductors in a confined space, we shall have to choose a lower density. Modern armatures are built in this way, and therefore we may select 2,000 amperes per square inch as a suitable value to adopt in fixing the size of our armature wire.

The calculation is a simple proportion. The wire carries 27½ amperes, and it is obvious, therefore, that its sectional area should be $\frac{27\frac{1}{2}}{2,000}$ inches, which is equal to ·013625 square inch. Here an economical consideration enters. It would not pay to have a special wire drawn for such a small machine as this, and we must choose the nearest standard size. Consulting a wire table, we find that the nearest standard size is No. 8 Brown & Sharp wire, the area of which is ·012966.

* *American Electrician.*

Then the question arises : How large must we make the armature core, and how many of these wires shall be wound upon it?

The size of the armature core depends almost entirely upon the number of wires that it must carry. It must have sufficient circumference to hold them all, and also to make room for teeth. To determine this, we must make a preliminary calculation. The total E.M.F. which this armature must generate is 110 volts for the lamps, 10 volts for the drop in the line, and we must further add a percentage for the drop in the armature. If we choose 130 volts as the total voltage the machine must generate, we shall be on the safe side.

The voltage, speed, flux, and number of conductors on a direct current bi-polar machine are related as indicated in the following formula :—

$$E = \frac{N C r}{100,000,000}$$

in which E is the total E.M.F. of the machine, N is the total number of lines of force, C is the total number of conductors on the surface of the armature, and $r$ the revolutions per second. Of these various factors, we know the following :—

$$E = 130.$$
$$r = 25.$$

Substituting these in the formula, we find that the product N C must equal 520,000,000. We are now at liberty to choose any value of flux and number of conductors which will multiply to that product. Here we must refer to practical experience to find out what is suitable in such a case. The following table serves to show the total fluxes employed in dynamos of various capacities of the high-speed drum type.

| Capacity in kws. | Conductor velocity. Feet per second. | Average useful flux. Lines of force. | Average leakage coefficient. |
|---|---|---|---|
| ·1 | 25 | 200,000 | 2·00 |
| ·25 | 30 | 333,000 | 1·90 |
| ·5 | 32 | 550,000 | 1·80 |
| 1 | 34 | 880,000 | 1·75 |
| 2 | 36 | 1,530,000 | 1·70 |
| 3 | 40 | 1,875,000 | 1·65 |
| 5 | 45 | 2,550,000 | 1·60 |
| 10 | 50 | 4,000,000 | 1·55 |

Our machine can run 100 lights, and is, therefore, a little over 5 kw. capacity, and hence we may assume any number of conductors that gives us a flux in the neighbourhood of from 2,000,000 to 3,000,000 lines. If we assume 3,000,000 lines as a flux, we shall find that we need :

$$520,000,000 \div 3,000,000 = 173\tfrac{1}{3} \text{ conductors.}$$

Of course, we cannot have a fractional number of conductors, but we can easily have any magnitude of flux we wish. Experience has shown that it is very convenient from a mechanical point of view to have the number of bars in the commutator, and, therefore, the number of conductors on the armature a multiple of six. Hence we may select 168 conductors as a convenient compromise, and dividing this quantity into 520,000,000 we find for our total useful flux 3,095,240 lines of force, nearly.

We are now concerned about the size of the core upon whose surface these 168 No. 8 wires are to be placed. No. 8 double cotton-covered wires, laid side by side in a winding, run about 6·66 turns to the inch, and if we laid these wires side by side around the circumference of a smooth surface armature, it is obvious that the circumference would be $168 \div 6{\cdot}66 = 25{\cdot}25$ inches, giving us an armature some 8 inches in diameter, which would be large for such a machine. It is evident that we must pile the wires one on top of the other in order to reduce the size of the armature. If we pile the wires two deep we would have an armature a little over 4 inches in diameter, which would be small, but if we allow a tooth width equal to a slot width, we should be back at 8 inches diameter. If we pile the wires four deep, the armature diameter would be 2 inches, but the teeth will add over 2 inches more, and the slot insulation will add still more. We may, therefore, make a preliminary calculation on this basis. Those who have read Prof. Rice's article will appreciate the fact that it is desirable to use two coils per

slot. The reason for having the wire a multiple of six now appears, for we can arrange our coils without having an odd number of slots or segments. In such a small machine it is not advisable to have too many slots, as it adds to the expense. It is obvious that the wires in the slot must be a multiple of four. If we assume four wires per slot, we shall have four wires per coil, and 42 slots and 42 commutator bars. This is convenient, for we shall have 24 bars across 110 volts, which is a little over 5 volts per bar, and there are enough bars to avoid pulsating currents. Moreover, a bobbin of two turns is not very inductive, which conduces to sparkless running. The slots should be at least of the following width to make room for the various insulating materials :—

| | |
|---|---|
| No. 8 wire ... ... ... ... ... | 128·5 mils |
| Fuller board trough ... ... | 70 ,, |
| Insulation ... ... ... ... ... | 25 ,, |
| Giving a total slot width ... | 223·5 mils. |

As these should be straight slots, because the wire cannot be wound four deep conveniently in any other construction, the teeth will be wedge shaped, being broader at the circumference than at the root. Practice has shown that it is not wise to have the root of the tooth less than 60 per cent. of the width of the slot. We then have the following items to make up the circumference of the armature ; 42 slots at 223·5 mils. each, equal 9·387 inches ; 75 per cent. more for teeth, 7·04 ; giving a total circumference at the base of the slot of 16·427 inches. The depth of the slot is, of course, equal to :—

| | |
|---|---|
| Four thicknesses of No. 8 insulated wire equals ... ... ... ... ... | 614·0 mils. |
| One thickness of paper insulating trough | 35·0 ,, |
| $\frac{3}{64}$ of an inch for clearance and band wires | 46·8 ,, |
| Total ... ... ... ... | 695·8 mils. |

It is obvious that, if we add double this distance to the diameter of the armature computed from the roots of the teeth, we shall have the diameter of the finished core disc. This quantity is 5·22 inches, to which we add 1·39 inches, giving us 6·61 inches as the core disc diameter. We will find it better to choose 6½ inches, because that is a standard size. The difference will be a slight narrowing in the thickness of the teeth at the roots, but it will not reduce them to less than 60 per cent. of the width of the slot.

Having computed the diameter of the core disc, we must determine the length of the armature, approximately. This is determined by the density of flux per square inch, which it is wise to carry. In armatures of this type, it can be safely advanced to 70,000 lines per square inch. We have approximately 3,000,000 lines, which means that the fluxed area of our armature must be at least 43 square inches. The effective flux carrying diameter of the armature, as we have computed, is about 5¼ inches. From this we must subtract 1¼ inches to allow for a shaft, leaving us an effective iron diameter of 4 inches. Dividing this into 43, we obtain a length of 11 inches for the assembled core discs. Having thus computed the general dimensions of the armature, it is necessary to make some calculations to see whether or no it will overheat. These will be considered in the next lesson.

## THE APPLICATION OF GAS POWER TO MARINE PURPOSES.

By W. H. BOOTH.

The *Mechanical Engineer*, which treats questions of motive power from the position of one who knows, had recently some pertinent remarks on gas engines. It is remarked how few double-acting gas engines have been put on the market, yet that such an engine is as much to be preferred as a double-acting Corliss steam engine, the ordinary drawbacks, such as difficulty in cooling the piston rod, and accumulation of caked carbon, being such as seem to be surmounted by care in design. The lack of progress is stated to be one of the disappointments of recent engineering, after the high hopes held out when the evolution of the gas engine had reached to the present stage.

Having got so far, further progress seems to be stopped. Now, as regards the steam engine, there has been no progress at all since this first became rotary, that is, no progress on the lines wherein the gas engine fails to fill certain requirements.

A steam engine will always start if steam be turned into it, and the crank be suitably placed, but not so a gas engine. The reason is that the steam engine has a store of energy behind it. Beyond this stage we never seem able to advance. We are told by the *Mechanical Engineer* that just in proportion as stored energy can be converted readily and quickly into mechanical energy, so is it dangerous. The smaller the quantity to be converted at one time, the greater is the difficulty. A large improvement was effected in the steam engine when it was perceived that the cylinder and the boiler had different functions. Is it not possible that a corresponding change in the case of the internal combustion engine might have the same effect ? The gas engine owes much of its superior economy to the fact that it more directly utilises the heat of combustion than does the steam engine, but it differs from the steam engine in one serious respect. In the steam engine no heat is intentionally wasted. Every endeavour is made, or is supposed to be made, to transfer all the heat of combustion of fuel to the water in the boiler, and, taken as a whole, a good boiler is the most efficient part of a steam power plant. Also we have learned to keep the working cylinder hot, and we add heat to its exterior surface so as to overcome certain internal losses. Now all this is changed in the gas engine. We are given an initial very perfect combustion of the fuel, and we find that the whole of the heat developed is transferred to the working fluid. Having obtained this working fluid, we are not possessed of the ability to use it. We commit that folly, in the eyes of the steam engineer, of abstracting heat from the working cylinder, for we surround it with a cold water jacket and abstract half the total heat, and as we throw away from a fourth to a third of the heat in the exhaust, only about a fifth is utilised. In spite of this, the gas engine has a higher thermo-dynamic efficiency than the boiler and engine combination.

Now a man has a higher organisation than a polyp. In one there is a separate organ for each duty. In the polyp a single amorphous mass performs the various duties of a dozen separate organs in the man, or other higher animal. On this line of argument, the steam engine is a higher organism than a gas engine, and in finding fault with the gas engine, this line of thought seems to have been taken by many engineers. Obviously, a heat engine, with a cold water jacket, is constructed on wrong economic lines, despite its comparative working economy. No one has yet been able to do more than mathematically omit the water jacket. Diesel omits it mathematically, and claims some 70 per cent. thermo-dynamic efficiency. In practice, he has to use the jacket, and content himself with an efficiency some way below 30 per cent. The next great improvement in the gas engine will probably be in the direction of securing a store of energy at a temperature not too high to be manageable. The likelihood is, that more complex organism will be necessary to do this. Until something of the kind is evolved, it is to be feared that the application of the gas engine at sea will not be practicable on the lines of steam engineering mechanism. But it is obvious that with producer gas and producer vessels containing a pressure, measured almost in eighths of an inch of a water gauge, the generator vessel of a war ship might be riddled with bullets and the holes plugged with clay without any serious inconvenience to the power of the ship. Such a fact alone offers a splendid inducement to bring the gas engine more within the line of controllable machines.

A gas engine may be started, and it will run continuously in the same direction, but it is absolutely wanting in all those qualities which we so much admire when we see a pair of marine steam engines turning first in one direction, then slowly or quickly in the other, stopping, moving, waiting, and moving full speed ahead or astern as the bell rings from the bridge, in such a manner, and in such strict obedience to the movements of the reversing wheel, that they appear almost sentient. This is yet undreamed of for the gas engine.

Its nearest counterpart would be the movement of the electric motor. There is nothing in view, except the driving of a dynamo, and the reconversion by a motor that will put the gas engine of to-day in a position to be handled for marine work. This brings us to the Heilmann idea. Applied to the locomotive, and with steam power, we may see no sense in the Heilmann engine. With gas power and electrical conversion, the largest steamship could be manœuvered by a child from the bridge. Once started, the gas engine would continue to revolve, and when not called on to do work, would keep running on perhaps less heat than is now lost by radiation from steam engines. Either at sea or in locomotive work, we may look to the Heilmann idea if gas engines are to be a success, and it is certain that gas power could be thus applied at sea on a less total weight of plant and for less fuel consumption than that of high-class steam engines. Reverting for a moment to the argument of multiple organism, may we not allow ourselves, until such time as the gas engine is improved on the lines indicated, to place the engine in the place of the boiler in the sequence of organisms, and, placing the dynamo in the position of the steam pipe, we have the place of the steam engine filled by the motor. In such a combination we should not perhaps have a prime mover under very close control, but we should possess every control over the actual motor, both for forward or backward movement, and there is no very serious objection to the keeping in continuous rotation of a gas engine at periods of alternate starting and stopping.

The difficulty with the gas engine is not that of starting it once, but of starting it, reversing, and stopping at short intervals. It is easy to start it by means of a small starting engine, no matter how large may be the main engines. By electricity alone can the mechanical defects of the gas engine be removed. Even with the wasteful jacket, the gas engine is an economical motor as compared with steam power. A gas engine at 20 per cent. efficiency, when combined with electrical conversion plant, will still show a combined efficiency of probably 18 per cent. By this combination gas power may at once be adopted for marine propulsion. Steam engines of large power are more economical than smaller engines. Gas engines do not show so much difference in this respect, and may be better kept below danger line in a war vessel than large steam engines. The power would thus consist of several units, and the knock out of any one unit would not cripple the vessel, but would merely reduce its maximum speed.

With all gas pipes kept down to the keel level the danger of a shot reaching them would be very small, and their accidental perforation could be easily repaired. The exceedingly obedient nature of the steam engine has probably caused the ideas of engineers to run in a groove and themselves to look upon reversibility and easy starting as indispensable qualities for a prime mover. Without the aid of electricity this idea is quite justifiable, but this newer agent frees us from the trammels of the idea, and we may conclude that the store of energy in a steam boiler, which makes the steam engine so convenient, is fully balanced by the convenience and economy of electric motors driven from continuously revolving gas engines.

If, therefore, it be allowed that the gas engine need not be called upon to reverse, then half the difficulties of its would-be improvers are gone at one stroke; there remains only to secure a better heat efficiency by getting over the excessive temperature difficulty. It seems to me that engineers are offered, in the gas engine, an economical type of prime mover. It has certain differences from the steam engine, and is more economical because it works more directly in its heat conversion from fuel to work. One result of this is that it does not possess the same mechanical convenience, such as reversal and prompt movements. Is it not our business as engineers to accept the gas engine as it is and make the best of it. We have been offered on one hand this new prime mover, and on the other the new power transmitter—electricity. Obviously, they are to be combined. It is open to argument whether the reversibility of the steam engine with its accompanying extra mechanism and friction is not obtained at as serious a cost as the electrical conversions in the suggested combination of gas and electricity. The power waste is simply transferred, and the final result is to the advantage of gas.

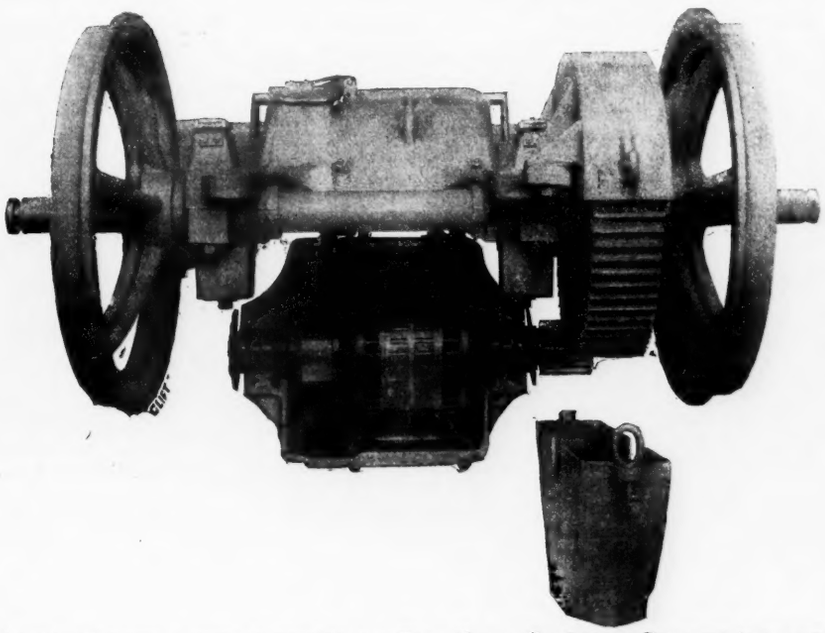
Even with gas generators below water-line it is by no means difficult to devise a complete gas power installation on a ship, including the apparently difficult storage of a reasonable volume of gas to give elasticity to the system.

It is hoped that nothing in the foregoing will be taken as evidence of any opinion in favour of the Heilmann steam locomotive. This may be left to "*une autre personne.*"

## THE BRADFORD CORPORATION ELECTRIC TRAMWAYS.

An illustrated description of the Bolton Road section of the Bradford Tramways appeared in our issue of July 29th. We are now able to supplement this account with further details, not only of the Bolton Road Tramways, but of the now nearly completed Great Horton route.

It may be said of this latter line that the construction was commenced at the same time as the Bolton Road line. It starts from the centre of the town, and runs practically up grade



Motor in Position.—Showing Lower Half of Field Magnet Dropped for Removing Armature.

the whole distance of 3½ miles to the terminus on the Great Horton Road, where the car shed is situated. This building is very similar to the Bolton car shed, but capable of holding 20 cars.

There are 1,496 yards of single track, and 2 miles 1·132 yards of double track. The total rise is 612 feet, and the maximum grade about 1 in 14 for a distance of over 240 yards. The line has also many sharp curves, some of 38 feet radius.

There is a loop line connected with the Great Horton road, which will supply tramway facilities to and from the Bradford Cricket and Football Grounds. The cars on this line are all to be equipped with roller bearings supplied by the Roller Bearings Company, Limited, of London.

We have previously stated that the power for operating these tramways is being supplied from the Corporation lighting station, the generators being arranged so that they may be used for either lighting or power work.

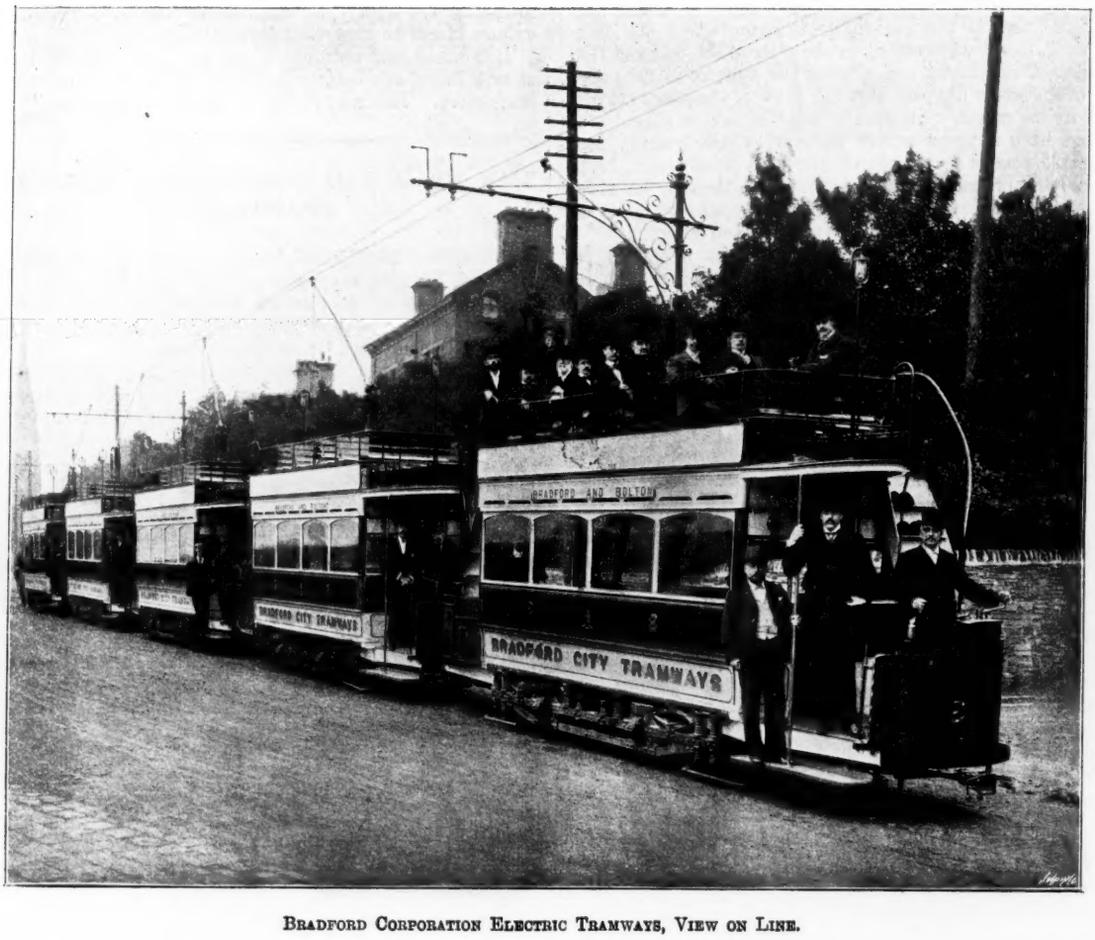
The line work on the Bolton and Great Horton roads is exactly similar, centre poles and side poles being used. The poles are 31 feet long, and buried 6 feet deep, and set in concrete. They are fitted with cast-iron joint rings, bases, and tops, and wrought-iron ornamental brackets.

The guards around the bases of the centre poles, instead of being faced with stone in the ordinary way, consist of a heavy cast-iron ring, projecting about 5 inches above the pavement, and of sufficient diameter to protect the pole from passing vehicles. This cast-iron ring is filled with concrete, and then faced off neatly with cement. The guard presents a very neat appearance.

The brush holders are especially strong and rigid. They are secured to the upper field casting, and provision is made for adjusting them radially, to allow for wear of the commutator. The dimensions of the bearings are amply large. The bearings and oil guards are outside the motor casing, thus rendering it impossible for oil to reach the armature, field coils, or commutator. Either grease or oil, or both, may be used for lubrication, the bearings having a grease cup above, and an oil reservoir with wick feed below.

The gears and pinions are wide faced and of ample size, to stand the heavy strains of tramway service. They are enclosed in an oil-tight casing, and the lower teeth are continually submerged in oil.

The motors are supported on the axle by bearings similar to those above described, and at the other end by a lug from the top field casting. This lug is secured by a link to a




Bradford Corporation Electric Tramways, View on Line.

The car motors are the Westinghouse No. 49, slow speed single reduction type. The field or stationary portion consists of two steel castings accurately fitted together with four inwardly projecting laminated steel poles firmly held together and cast into the yoke. This method of construction insures a very powerful magnetic field, and eliminates the losses due to eddy currents. The two halves are hinged together on the side opposite to the axle, and can easily be opened for inspection of the interior parts. The field coils, armature, commutator, &c., are completely enclosed. There is, however, an opening with a spring lid that permits of inspection of the brushes, &c. The field coils are machine wound and thoroughly insulated. There are four field coils.

The armature is of the drum type. The coils are machine wound, and lie in slots around the periphery of the laminated core. Ample means are provided for ventilation of the core and conductors.

The commutator is composed of hard drawn copper segments, insulated from each other by sheets of mica. Ample margin for wear is allowed.

cross piece, which is supported with spiral springs at each side of the truck. One of the illustrations shows the motor attached to the car frame, the lower half of the field magnet being dropped for removing armature.

The controller is of standard Westinghouse manufacture, and is known as the No. 90 brake controller. It is of the series parallel type, and is designed on the same general lines as the other controllers used by the Westinghouse Company in their tramway work. The special feature of this controller is that it is arranged so as to utilise the motors as electric brakes. The motors are reversed, and are thus made to act as generators, the current so generated being passed through graduated resistances. By increasing and decreasing the amount of resistance in the circuit, the braking action may be regulated at the will of the driver. An excellent feature is, that only one handle is used for both power and brake, the driver simply pushing the handle in one direction for driving the car ahead, and in the opposite direction for braking. The operation of this method of braking is found to be most satisfactory. The car may be brought to a standstill very gradually, and without the slightest jar or discom-

fort to the passengers. On the other hand, in case of emergency, the car may be stopped very quickly. The principle of converting the motors into dynamos, and thus making use of their braking action, has been applied before for the purpose of an emergency brake, but several operations have been usually necessary on the part of the driver to accomplish the desired result. By the system used at Bradford, a thoroughly efficient brake for regular service is secured, and this without additional apparatus, and with an arrangement of handles which, so far from increasing the difficulties of manipulation, rather simplifies the duties of the driver.

Each car is fitted with a standard platform switch at one end, and an automatic switch cut-out at the other end. Both switches are mounted on the platform of the car, and are in easy reach of the motorman.

The automatic switch cut-out is fitted with a magnetic release, and is set to open when the current passing exceeds a certain amount.

## CORRESPONDENCE.

### American Machinery Abroad.

Our American cousins have a habit (and I believe they like it) of spending one or two months per annum in this country. Happily our electrical brethren on the other side of the water are not entirely oblivious of the charms of London, and when, as occasionally, they do find time to visit our little island, they not only cheer our hearts with their descriptions of the progress of electricity, but their presence is a source of delight to all of us who may have the good luck to spend some time in their company.

These pleasant visits are, of course, very short, but an American is a hard worker, even on his holidays, therefore the time he spends here can scarcely be taken as a measure of the knowledge he acquires. In fact, he acquires a great deal. The pity of it is that he cannot find time on his return to impart some of his knowledge to the editors of his local technical journals, who, as we all know, are men of great energy and ability, but unfortunately singularly devoid of a broad knowledge of the conditions of electrical industry in England. For instance, the *Electrical Review* (New York) of August 3rd publishes an interesting account of an exhibition by the Westinghouse Company of three 2,500-H.P. steam dynamos, which they are supplying to the Metropolitan Electric Supply Company. Truly a fine order, but they try to make it look finer still by describing the Metropolitan Company as "the greatest electric lighting and power company in London," and by stating that "the said company is about to establish new central stations all over London. . . . and it is generally believed that the Westinghouse Company is to supply the power apparatus."

These statements will probably be as interesting to the Metropolitan Company as to your readers generally. Of course the Westinghouse Company may very naturally and properly feel elated, but if they fully realised how firmly the taste for variety is imbedded in the minds of the directors of the Metropolitan Company, they would "*believe*" that the next order would be more likely to go to Berlin or Tokio than to come to them.

The *Engineer* (American) of August 1st supplies another illustration of this same absence of knowledge; in a short but lively article on "American Machinery Abroad," it adds just one crow more to the general cock crowing which followed the placing of the order for the Central London Railway plant in American hands. The *Engineer* looks forward confidently to the whole of the heavy work of England being placed in the States. "Matters will be practically the same for the next contract, and the next, and so on indefinitely, and the American will constantly be securing increasing evidence of his experience in the construction of heavy work with demonstrations of his capacity everywhere, and the English maker will be distinctly 'not in it.'"

This bold prophecy is made apparently in ignorance of the fact that English engineers are filled up with orders, and do not know which way to turn to execute them, whereas American engineers are not so full but that they can do some of our work as well as their own. The idea suggested that England is a child in mechanics is sufficiently controverted by our marine engineers, who have led the world in mere size as well as other matters, and in face of conditions compared with which the conditions of electric traction, exaggerated for trade purposes by engineer bagmen, are mere samples of simplicity.

On the whole we ought to be thankful to our friends on the other side for advertising their burglarious intentions so much in advance, and if we are wise we shall proceed to take all necessary precautions.

We are not deficient in engineering skill, but we cannot shut our eyes to the fact that we are short of engineering capital. As a rule our manufacturing establishments are slowly developed out of profit—far too slowly to meet the wants of this advancing age. The investing public has never been keen on pure engineering investments because engineers seldom or never make huge profits, though they make steady ones. Your investor likes to be certain of 5 per cent., but he also likes to gloat over a visionary 50; so, while "Kaffirs" and "Cycles," and such, drain his resources, the solid engineering development of the country is left entirely to individuals who may be content to live on little, rather than restrict the growth of their businesses.

Is there no cure for this?

There is a cure, a cure made in Germany, viz., the establishment of industrial banks; these banks invest their balances in improved industrial developments, in which they have usually a controlling interest. The investor or depositor in these banks knows that his money will be used with the greatest skill and intelligence, and only on the most complete investigation, whereas the British investor knows nothing at the right time, although occasionally at a later stage he learns much that surprises him. In matters electrical, the British investor has been aided by the skilful advice of the Electrical and General Investment Company, which has done for us the technical investigation undertaken by the German banks; the result has been eminently satisfactory, but it has covered only a very small area, and only a comparatively small number of investors have had the faith which comes of knowledge to enable them to profit by the advice given, but these few have gained much and lost nothing.

The Industrial Bank would not only assist in the development of our trade, but it would bring into the pocket of the investor a large proportion of those disbursements for trimmings which *come out* of the pocket of the shareholder, but where they *go to*, the Lord only knows.

John S. Raworth.

### Submarine Telegraphs.

Being away from home, I am unable to reply in detail to your reviewer's not over generous, or over charitable, attack on my book, of which I have only some slip proofs by me.

I venture to think that it is just such reviews as this that might well be signed, not for satisfying the curiosity of the reviewer (? author, Eds. Elec. Rev.)—that would, in any case, be unnecessary in this instance—but rather for the sake of justifying in the minds of readers the lofty—not to say sneering—style adopted throughout. [It is even possible that in some instances your reviewer's scathing remarks would not be taken as absolute gospel, and that the "appalling misconception" would be thought to apply equally well to himself.] Such a style of reviewing is not difficult.

Maybe the writer has not attempted the task of preparing a similar compilation; but he has evidently satisfied himself that if he did it would be something infinitely superior.

Your reviewer's object is rendered pretty clear by the personalities introduced. For instance, he thinks fit to lead off with "fears" (!) that "the book will not make the reputation of the author." Again, what need to introduce the sneer "from a man professing to be a telegraph engineer?" Moreover, where is the necessity for entering into speculations as to my views of matters astronomical when only a column and a quarter is devoted to discussing a large octavo volume composed of nearly 750 pages (and containing over 350 illustrations), entitled "Submarine Telegraphs: their History, Construction and Working," only the second of which sub-titles the reviewer deals with?

Space is found for such purely personal observations as I have quoted above in the course of his professed review of a

*book* rather than of an individual, yet no space can be found for any statement of the contents generally for the benefit of possible readers or purchasers.

Your reviewer is good enough to say "there are doubtless good points in the compilation." Seeing that he has evidently made it his business to discover and point out—in a not over pleasant way—what he thinks to be errors, he might, perhaps, have done well to search a little more diligently in the other direction also, or else leave the speculation alone altogether.

What a grand pedestal your reviewer must stand on to be able to criticise another's "knowledge of the subject" as "not perfect"! He may, indeed, be envied if he has attained that perfection himself!

And now I come to your reviewer's actual criticisms, I can safely say at the outset that, in meeting his ends, your reviewer has shown remarkable skill in quoting parts of paragraphs which, if taken by themselves read in the way he wishes to imply. This applies to his first criticism. If he had chosen to quote down to the end of the paragraph in question—and had avoided cutting out one sentence entirely—no such construction could have been put on my understanding of the matter. The next point mentioned would be obviously recognised as a clerical error by anyone impartially reading the rest of the section. I am not attempting to defend clerical errors, but most reviewers—certainly those who are authors as well as critics—recognise that they do not deserve the rough treatment here given. A similar answer may be made to the criticism that follows. Then comes the reference to Willoughby Smith's gutta-percha, to which the same applies, as is rendered fairly clear by the formula being compared with that for ordinary G.P. With regard to my remarks on the pressure test of a core as opposed to submerging a length of sheathed cable at the bottom of the sea, I would recommend your critic to try some experiments in both directions, and then perhaps he will recognise that the result is liable to be different. The next objection regarding the controlling features in the lay of a cable I fail to follow, and also that which follows. The next criticism refers to what professes to be a quotation, but is not. If the entire paragraph is read, a different construction is arrived at, and one that I see no reason to withdraw. Your reviewer then commences to give page references for the first time. In his reference to page 87, your critic should have quoted the entire paragraph to which he "loosely" refers, before finding fault. The next three errors I am much obliged to your reviewer for pointing out, though I should have been glad if his remarks had been characterised by a little more generosity and charity. They are slips which I venture to think anyone might be capable of in the course of a book like the one under discussion, and which explain themselves fairly clearly in other formulæ or text, as the case may be. After reading the entire sentence to a part of which your reviewer next refers, I cannot help thinking his criticism somewhat unnecessary. The point he brings forward—even if it covered the whole story—is somewhat trivial there; besides which it will be found more suitably referred to elsewhere. Perhaps, however, I should have used the expression "theoretically speaking."

Your reviewer ends up by a casual allusion to what he calls the "historical and descriptive portion" of the book. Possibly because he finds himself in shallow water your critic contents himself here with asking, "What is the good of it all?" This, presumably, is merely put forward as an opinion—though not particularly gracefully. Happily there are those—perhaps equally intellectual—who find it useful to know what has gone before and the way things came about—not to mention those who, whilst unconnected with the work professionally, take a sympathetic interest in reading of it in a historical light. But if your reviewer wishes to imply that the historical part forms the larger portion of the book, his sense of accuracy has curiously deserted him, for Part I. is composed of 210 pages, as against 312 for Part II. on "Construction."

I notice, by the way, that Part III. (181 pages on "Working"), though containing the greatest amount of novelty, your reviewer leaves entirely alone—possibly for the same reason that he holds his tongue with regard to Part I., whilst endeavouring only to pick holes in Part II., and sneer at its author.

Finally, let me say that the proof sheets had to be read through at great disadvantage; and—though I have no desire to exculpate myself from errors under any heading—considering the dimensions of the book, I think perhaps a little more grace and charity might be expected.

I trust that you will see the justice of giving your readers the same chance of reading this that you have given them of reading the review in question.

**Charles Bright.**

St. Leonard's.

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### Heating Apparatus (in August!)

As an amature I am constructing an electric heating aparatus.

I have got a quantity of platinoid wire, 28 Birmingham wire gague. Could yow or any of your readers inform me the exact length of this wire I should require to maintain a heat of 2,000° in same with a current of 9 amperes at 200 volts. If yow could furnish me with the above information yow would greatly oblige, yours faithfully,

**Harry Fenn.**

P.S.—Perhaps I should mention that I shall apply the current to each end of the wire so as to work at a dead resistance in the length of wire.

[We shall be only too happy to leave this to our readers. —Eds. Elec Rev.]

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### Dynamo Fault.

Will you please answer the following through your columns:—

We have a shunt dynamo with notched armature and F.M's. of the softest wrought steel, giving an output of 50 amperes at 100 volts, 400 revolutions per minute.

Occasionally this machine while working ceases to excite, and even when on no load it is not improved by materially increasing the speed. The above freak has occurred when a much smaller current than the maximum was being taken from it.

Though the machine can be restarted by separate excitation the fault seems still to recur at intervals.

**Abnormal.**

[Without an examination of the machine, or some particulars as to details of construction, it is not easy to account for its behaviour, as such bad conduct may be due to several causes.

Sometimes failure to excite is due to using carbon brushes making bad contact on commutator; remedy, make good contact, or use copper wire or gauze brushes of good make.

Probably the armature resistance is too great and also the field magnet resistance higher than usual (in order to get the low speed) and these cause failure to excite; remedy, compound the machine.—Eds. Elec. Rev.]

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**Waste Gas Temperature with Forced Draught.**—The *American Electrician* is responsible for publishing a statement that with a fan forced draught and no economiser feed heater, the temperature of the waste gases at the Sturtevant Company's own works is only 222½°. We like the half degree better than the 222°. Absolutely no particulars are given as to the boilers, but we do not believe this temperature, for it is far below that of any probable boiler at ordinary everyday pressures. With such a final temperature, even the 11-lb. evaporation from and at, appears very low, while if the low temperature is produced by an enormous access of air—perhaps designedly to keep the fan cool—then is 11 lbs. rather a high duty. If electrical engineers and journals continue to get flue gases below boiler temperature, there will have to be an alteration made in the at present accepted law of heat, which says that heat cannot pass from a cold to a hot body. Apparently it has begun to do so.

## BOILER FEEDING BY INJECTORS.

By JAMES WHITCHER.

If with thoroughly open and impartial minds we start to argue out the problem of boiler feeding, we find ourselves led almost irresistibly to the conclusion that injectors should afford absolutely the best and most economical of the several methods available; so much so, that we begin to wonder why it is not the universal method, for its use entails no waste of heat, and its mechanism is of the simplest possible character, and of cheap, compact, and durable construction.

Yet, in practical circles, we find that, apart from the strikingly unanimous confidence that is reposed in it for locomotive purposes, the method is viewed with deepest and general mistrust. One scarcely ever hears a good word for injectors applied to stationary boilers. Engine drivers and stokers, as a class, would have none of them if they could help it; and where a pump and injector are fixed together to share the work the pump will be used, though in the last stage of ruin, while the injector is left to rust in idleness. When a reason is sought for this strong prejudice the answer is, that injectors cannot be relied upon, and that they use too much steam.

Now, it is evident at once that the former charge is an unjust one; for if injectors are not to be depended upon for general purposes, they would be equally unreliable for locomotives, and that is contrary to experience. Besides, plenty of instances can be adduced, particularly relating to low pressure boilers, where, in spite of the prejudice of attendants, single injectors (without a stand-by) have performed their duty in a thoroughly satisfactory manner for long periods, and required scarcely any attention or overhauling. It is, in fact, often the valves that give the greater part of the trouble that there is.

The second charge is of more importance, and it has undoubtedly a real foundation in fact, although the why and wherefore of it is a veritable puzzle, in view of the absolute absence of any avenue of escape for the energy that is apparently wasted in very liberal measure. Usually on the starting of an injector, the boiler pressure begins falling in a rapid decisive manner, that means some anxious moments to the stoker, especially if he has the misfortune to be located in a district where smoke is under a strict taboo, and he has to be particularly canny with his dampers. The recovery is comparatively quick, but in the stoker's mind this does not go down to the credit of the injector. He ascribes it rather to the cessation of its baneful influence; and even when he does realise that this recovery is quicker than it would have been if the water had been pumped, there is not much comfort for him, for it is the fluctuation of pressure that concerns him most; and his grievance is that he cannot avoid it except by the short and frequent system of dosing his boiler, which he naturally abhors.

Probably this objectionable characteristic in the working of injectors is largely due to the use of a size too large for its average duty. The feed water is supplied at too rapid a rate for the furnaces; and this rate of influx is not visible as it is in the case of pumping, and is not so easily regulated. The intangible mode of operation of injectors is necessarily a considerable obstacle in the way of confidence in their use, and a simple and effective indicator fitted to them, showing the rate of flow into the boiler, would be of much service. An injector so fitted, and constructed so that the rate of feed could be regulated over a long range, would be the equal of a pump in point of convenience of working. But for lack of these features the stoker has certainly a true bill against the injector, and good reason for his preference for a pump. The latter gives him a sensitive means of controlling the pressure, additional to mere manipulation of the furnace, whereas the injector practically deprives him of it—not, of course, that it is impossible to regulate the feed with some forms of injectors, but the requisite judgment and familiarity in using the apparatus is not so easily acquired.

There is good reason for the belief that injectors are big steam eaters. For under many conditions they must be delivering the feed nearly at boiling temperature, and sufficient steam is consumed to effect this. Thus supposing a supply of feed water for half an hour's consumption is put into the boiler in the first five minutes. If pumped, the cool water lies low in the water space, and takes heat, mostly from the furnaces, and at a fairly constant rate throughout the whole period of 30 minutes. But if injected, the feed is not only delivered, but also heated nearly to steaming point, within the short period, and the extra duty is done, not direct by the furnace, but by the store of steam. Steam is made quicker during the subsequent 25 minutes, but the effect is a pronounced fluctuation of pressure, being a rapid fall followed by a slower rise, and the variations are too sharp to be modified easily by the mode of firing. The excessive draught on the store of steam produces almost as serious a fall of pressure as would result if the cool water from the pump were to be sprayed into the steam space, instead of delivered in a sluggish stream below the water level.

These fluctuations are not actually so very serious an objection to the injector, and they would be much less significant if stokers would only educate themselves up to an intelligent use of the appliance. The chief trouble is that it forms so ready a handle for aspersions on the economy of injectors. Immature reasoning faculties find in the travelling back of the steam gauge, when the injector is turned on, triumphant proof of its wastefulness too conclusive to be confuted by any argument to the contrary; and it is useless generally, in the face of this conviction, to argue the impossibility of there being any real waste.

However, there are two counts on which indictments may be urged against injectors with a greater show of reason. These are that their use depreciate the efficiency and working capacity of the boiler, and the efficiency and capacity of the feed heating devices, if any. Now, as to the first, we have it on good authority that live steam feed heaters, far from diminishing the efficiency and capacity of boilers, increase them by upwards of 10 per cent. This surprising fact was indubitably established some time ago by the experiments of Kirkaldy and others; but it is not at all clear yet whether it applies equally to all kinds of boilers, and to all conditions of working. If it does, it is no more possible to maintain that injectors, any more than feed heating devices of any kind, have a deleterious effect on the working activity of the boiler. Their influence, instead, should be quite the other way.

Were it not for the startling result of the above-mentioned investigations, we should not have much hesitation in assuming that a cold feed would induce a more rapid transmission of heat than a hot feed, and therefore that the work proper obtained from the boiler is greater in the former case than in the latter. It tells us, however, that the reverse is the case; and the reason why is very obscure, no satisfactory explanation being possible with our present knowledge of the operation of heat transmission in a boiler. But the practical meaning of it all is that feed heating makes for economy, not only because of the net amount of heat added, but also because of the mere fact of its elevating the mean temperature of the boiler contents.

As to the second count we are on surer ground. For instance, it would certainly be a mistake to pass the feed water from an injector indiscriminately through an exhaust feet heater, for little heat could be gained, and some might be lost. As most injectors are unreliable if supplied with water at a greater temperature than 100° F, we cannot gain much by drawing the supply through such a heater beforehand, and there is always the risk and inconvenience of its becoming overheated. Likewise with economisers; unless there is a substantial difference between the temperature of the feed delivered from the injector and the economiser temperature, the feed-heating device becomes of negative value.

We can now perceive that in this bye-path lurks the one real and economical objection against the injector. For evidently the price of its use may be the sacrifice of feed heating by the waste heat, and it is of serious magnitude. Suppose, for instance, that the working pressure is 140 lbs., that we feed the boiler by a pump of 50 per cent. efficiency through an exhaust heater, raising the temperature of the feed from 100° F. to 200° F. One pound of steam will pump 100 lbs. of water, and the heat thrown away in the pump exhaust is 1,120 British thermal units, whereas the heat abstracted from the heater is 10,000 units. An injector would save the former quantity and reject the latter, which indicates a very large balance in favour of the combined pump and heater.

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From the practical point of view, therefore, we see that it is bad policy to use an injector where feed heating is possible, and that it is also bad policy to use a pump, unless in conjunction with a feed heater. Thus there is a very clearly defined line of demarcation between their two respective "spheres of influence" and utility.

At first sight, it does not appear as though the mere question of mechanical efficiency could have any decisive influence on the application of injectors to boiler feeding. It seems quite beside the point, seeing that thermal efficiency is the real desideratum, the which, in this case, is unity. Theoretically, boiler feeding does not imply any expenditure of work; it is simply the exchange of a volume of steam for an equal volume of water; and, since with suitable temperature conditions the steam may be condensed by, and form part of the volume of water, there need be no loss of heat in the exchange. We assume, of course, that the levels of water in the boiler and feed tank are the same. There is no work lost, except in the friction of motion; and this appears again as utilisable heat; hence no heat disappears on conversion into work.

Where the mechanical efficiency of the injector becomes a significant factor is, that it may be so bad that there is necessarily a large difference between the feed water as supplied to it and as delivered from it. This temperature difference constitutes a very accurate and, indeed, absolute measure of the injector efficiency. It shows definitely how many unit volumes of steam have been absorbed to deliver each unit volume of water. If the difference is large, the function of feed heaters is, as we have seen, very seriously interfered with, and so a very momentous, though indirect, disadvantage is introduced.

An injector which could take water at, say, 60° F., and deliver at 80° F., through a heater in the boiler, or take water from the heater at, say, 200° F. and deliver direct to boiler, and do so over a full range of varying loads, could encroach very successfully on the province of the pump. The second condition is apparently impossible unless the water supply is under pressure, and the former is probably impracticable over a range of loads, and anything in excess of this would, under average conditions, make the combined efficiency of injector and heater decidedly less than the combined efficiency of pump and heater.

Hutton, in his valuable treatise on "Steam Boilers," states that the average performance of injectors is to deliver from 10 lbs. to 18 lbs. water per lb. of steam. Now, at 140 lbs. working pressure, about 200 lbs. water should, in theory, be exchanged for 1 lb. of steam. Hence the mechanical efficiency of injectors ranges below 10 per cent. With the highest theoretical efficiency of exchange, *i.e.*, 100 per cent., the temperature rise of the water injected would be somewhere about 5° F. But Hutton gives a table for the average rise of temperature in practice, which states that with a working pressure of 40 lbs. per square inch, the rise is from 100° F. to 145° F.; at a pressure of 100 lbs. it is from 120° F. to 175° F.; and at 200 lbs. pressure it is from 145° F. to 255° F. It may be possible to obtain better performances than these; but as they stand it is evident that exhaust feed heating in conjunction with such injectors would be scarcely wise.

Apart from this question of feed heating, the injector merits preference above all other appliances for boiler feeding. It is so neat, compact, and easily applied, and, at the same time, cheap and effective, that it ought to be in better and more general favour than it is. It would reap better opinions if attention were given to the following points in installing it: Firstly, as a precautionary measure, two injectors of equal size should be used in each instance, and their combined capacity should be about equal to the maximum rate of feed required, and ought not to greatly exceed same. Secondly, the two injectors should be mounted quite independently of each other, and so that either can be easily dismantled and overhauled during working hours.

Indeed, these are advisable modes of procedure in the case of any boiler feeding or like appliances. Apparatus that can only be overhauled after hours is bound to receive the scantiest possible attention, and of a sort that is too hurried to be intelligent. Thorough duplication, if not carried to excess, is the truest economy in the long run, saving much in the way of emergency repairs and renewals, and securing the best working conditions; and where feasible, it is only just to the attendants to provide it. For steam raising plant is especially exacting in the overtime duty it demands of them, and some thought ought to be given to the lightening of those duties in the designing of same.

## THE ELECTROLYTIC DEPOSITION OF GOLD.

The following is an abstract of a paper by E. Wohlwill in the *Zeitschrift für Electrochemie*, IV. (16), (17), and (18), 379—385, 402—409, 421—428. A very lengthy article, giving the results of experiments made at the Nord-deutsche Affinerie, Hamburg, Pettenkofer showed 50 years ago that gold purified by the usual sulphuric acid parting process always contained small amounts of platinum and silver. The utility of nitre as a purifying agent he proved to be due to its oxidising action upon the platinum, and he was able to show the presence of platinum in the nitre slag from such fusions. The practical results of these discoveries was the aqua-regia parting process for gold and platinum.

The Hamburg Nord-deutsche Affinerie chemists commenced to investigate the subject of the electrolytic separation of gold from platinum and silver 20 years ago, and at the Paris Exhibition of 1881 a bar of electrolytic gold, testing $\frac{1,000}{1,000}$ fine, was shown.

The method of electrolytic parting has been improved since that date, and is now patented in Germany, England, the Transvaal, and the Australian colonies. Good chloride solution was the only possible form of electrolyte; the cyanide was not practicable, since both silver and copper—impurities of raw gold—form soluble cyanide salts; and the electrolytic gold produced by the Siemens and Halske process always contains the silver and copper present in the electrolyte. E. Wohlwill found, however, that neither a neutral solution of auric chloride, nor a solution of the hydrogen auric chloride salt, would serve his purpose, since the chlorine liberated at the anode did not attack the raw gold, but either escaped as gas or reacted with the water, and liberated oxygen. This is all the more remarkable, since, if hydrochloric acid be electrolysed with a gold anode, solution occurs. The author explains the different behaviour of the gold by the theory that solution only occurs when the salts, H Cl, Na Cl, K Cl, &c., are present in the electrolyte in sufficient quantity to permit the formation of complex salts of the hydrogen auric chloride type; that is, when the conditions are favourable to the production of the ion, $Au Cl_4$. Hittorf showed long ago that when solutions of complex salts of this type are electrolysed a complex anion separates at the anode. In the case of the anion, $Au Cl_4$, the deposit of gold at the cathode is due to a secondary reaction between this, $Au Cl_4$, and the hydrogen or potassium liberated at the cathode. The presence of the ion, $Au Cl_4$, in such an electrolyte can be proved by adding silver nitrate. A complex precipitate containing gold is first formed, and the silver chloride, which eventually separates on standing or exposure to light, is due to a secondary reaction. In the conduct of the electrolytic process at Hamburg, the conditions favourable to the solution of the gold anodes are obtained by continual additions of hydrochloric acid to the anode chambers of the cells. The higher the current density employed, the more frequent must these additions be. Increase of temperature of the electrolyte has the same effect, and if chlorine has commenced to escape as a gas at the anodes, it can be stopped by heating the electrolyte. If sufficient hydrochloric acid were present, E. Wohlwill found that a current density of 300 amperes per square metre (273 amperes per square foot) might be safely used; and under these conditions a plate of gold 4 mm. thick and 4 kilos in weight could be wholly dissolved by a current of 308 amperes in five hours.

In actual work a current density of one-third the above and an E.M.F. of only 1 volt is used. The time required for the solutions of such a plate of gold is thus reduced to 15 hours.

The gold is obtained at the cathode in coarse crytalline particles, which do not fall away from the surface, but which can be easily detached by mechanical means. The electrolyte should contain 30 grammes of gold per litre. The electrodes

can be placed very close together, as there is no "treeing" of the deposit, and the volume of electrolyte required per cell is therefore not great. The depositing vats of the Frankfurter Gold u. Silber Scheide Anstalt, in Hamburg, suffice to yield 75 kilos fine gold per 24 hours, yet they only cover a ground of 6 square miles.

All the constituents of the anode, with the exception of the silver, pass into solution, but owing to the lower E M.F. required to liberate the gold, only this metal is deposited. The electrolyte is used for some months before the separation of the platinum and palladium is effected by means of ammonium chloride. The silver is found as anode slime on the bottom of the cell. The average fineness of the electrolytic gold is over 999·8.

E. Wohlwill next considers the advantage of the electrolytic method of separation, as compared with that by means of ferrous chloride from the aqua-regia solution.

Under certain conditions named in the patent specification, this electrolytic method of parting the noble metals can be used for many of the alloys used in exchange, or in the arts.

The weight of gold deposited at the cathode per ampere-hour varied greatly in all the experiments, but it was always in excess of the theoretical amount calculated from the electro-chemical equivalent for trivalent gold. E. Wohlwill was led to suspect the presence of monovalent gold ions in the electrolyte, by noticing that the gold found with the silver chloride slime beneath the anodes had not the appearance of mechanically-separated particles, but appeared to be the result of secondary chemical reactions. He assumed, therefore, that both aurous and auric chloride are formed at the anode, and that the former then decomposes to form auric chloride, according to the following equation, $3\,Au\,Cl = Au\,Cl_3 + Au_2$. A similar reaction is held to occur in copper refining. The presence of these monovalent gold ions in the electrolyte leads to the transfer of a certain proportion of them to the cathode by the action of the current and to the variation in the amounts of gold deposited per ampere-hour. This theory also explains the facts relating to the loss of weight by the anode, which is greater for a given amount or current than would be the case if only the trivalent gold salt, $Au\,Cl_4\,H$, were formed. E. Wohlwill gives some tables of results showing the connection between the loss of weight at the anodes and the current density and temperature of the depositing cell. A high current density was found to promote the formation of trivalent gold ions, but the experiments require to be conducted under exactly similar conditions as regards temperature and acidity of the electrolyte, in order to observe correctly the effects of varying current densities. The practical advantage of high current density is the diminution of the gold found in the silver chloride slime, since the supply of the monovalent gold ions is reduced to a minimum, and the secondary reaction noted above cannot occur.

The experiments described above were undertaken under conditions which permitted free circulation of the electrolyte from anode to cathode. Under other conditions the results obtained would be different.

E. Wohlwill finally carried out some experiments in order to see whether continued diminution of the current density would lead to the production of a greater number of monovalent ions of gold at the anode.

The solvent action of the electrolyte upon the gold anode at the temperature used (65°—70° C.), even when no current was passing, had to be allowed for in these experiments. A fall of temperature in such a solution can also cause increase of weight of the anode, due to the gold set free by the reaction $2\,Au\,Cl = Au\,Cl_3 + Au_2$.

Allowing for all these disturbing influences, it was found possible to obtain direct proof that a diminishing current density causes increase in the ratio of monovalent to trivalent ions of gold. In other words, the electro-chemical equivalent of gold increased as the current density diminished. With a current density of 136 amperes per square foot, or over, it is at a minimum, and nearly equal to that calculated for $Au^{111}$; with a current density of 0·09 ampere per square foot it is at a maximum, and but little below that calculated for $Au^{1}$.

This peculiarity of a metal forming simultaneously by the anode, ions of different valencies may possibly find examples in the case of other metals.

## POWER TRANSMISSION BY BELTS AND PULLEYS.

Such enormous amounts of power have been wasted in the past by belts and shafts and gearing generally, that the question of a little more or less has not attracted the attention it should have done. Probably, in the future, when electrical driving becomes more common and the power to drive a machine can be so easily found, it will become apparent that the direct driven machines use so much less power than belt driven machines, that attention is likely to be directed to belts, with a view to reducing their frictions and other wastes. Mr. C. L. Redfield some time ago drew attention to the subject in the *Engineering Magazine*. He is of opinion that belts have been neglected in the rush after electrical transmission, this neglect of old methods being a usual custom, and often leading to undue condemnation. In designing a belt system there are many items to consider in arriving at a suitable compromise. There is the shaft diameter and speed, the diameter and face of the pulleys and the belt size, and these are capable of a large number of combinations.

The first loss in a belt is that due to bending it round the pulleys and unbending the same. Though small the loss occurs at four points in each belt. To transmit a given power there must be so many cubic inches of belt pass any given point in a given time. To do this we may either run a large belt slowly or a small belt quickly. The product of area and velocity must be constant.

As the bending force varies as the breadth and as the square of the thickness and as the amount of bend, a 2-inch belt offers simply twice the resistance of a 1-inch belt; a belt ¼-inch thick offers four times the resistance of one only an eighth thick. Hence a 1-inch belt of a quarter thickness has double the resistance of a belt 2 inches by one-eighth. Yet they are equal in area. Hence belts should preferably be wide and thin, and as resistance increases with the amount of bend the larger pulleys offer the least resistance, and as they also give the higher belt speed and allow of smaller belts we see that thin belts on large pulleys are the best for economy in every way. Thin belts also have better grip and slip less, and, therefore, do not require to be so tight as thick belts. The working stress being merely the difference of the tight and slack side tensions, the pull on the bearings is less. Every additional pound of pull on the slack side implies a total extra pull of four pounds on the two shafts. Hence also there is an advantage in wooden and in leather covered pulleys. In respect of shafts their resistance varies as their speed and diameter, and their power varies as their speed and as the cube of their diameters. Thus a 2-inch shaft is eight times as powerful as a 1-inch shaft, and a shaft at 200 revolutions transmits double the power of a shaft at 100 revolutions. Now loss by friction varies as the load or journal pressure multiplied by the speed.

Considered alone the friction speed is a direct function of the diameter: the weight varies as the square of the diameter so that the friction loss varies as the cube of the diameter. A shaft alone, therefore, has an equal frictional loss whatever its diameter. If a shaft carries other load than itself, every reduction of diameter with consequent increase of speed increases the friction. Larger and slower shafting is thus economical when a shaft has extraneous loading. But with high speed of belts the pull of a belt diminishes, and so far a high speed shaft will have a less load on it than if it ran more slowly. This points to economy with small high speed shafts. But the gain becomes small as speeds become high especially, because the friction surface moves a greater distance under the load. Moreover, larger narrow pulleys are heavier than smaller wider ones and add to the load. Centrifugal tension demands greater tightness and the maximum velocity is limited to somewhere from 4,000 to 7,000 feet per minute. The lower limit, we think, is more likely to be the more economical. The author has prepared several useful tables to facilitate the investigations he suggests should be made into a design. No. 1 is a table of shaft diameters for various powers at speeds from 100 to 400 revolutions. This enables one to compare the requisite shaft equivalents. No. 2 gives the speed of belts on pulleys from 8 to 54 inches diameter at from 100 to 400 revolutions, and the pull on the belt for one horse-power. Table 3 gives the surface speed of shafts of various diameters at various speeds, and Table 4 is one of approximate pulley weights. A system of shafting is assumed for illustration, driving four machines by countershafts placed two on opposite sides of the main shaft. The calculations are made on the basis of journal friction alone, though some of the changes made from the original plan, as the use of larger pulleys, bring in other economies. The example shown is quite an ordinary arrangement. Calling the coefficient of friction = $k$ = ·075 and taking out all the pulls and loads, he finds the friction of a 20 horse-power transmission to be 3·602 horse-power. Inspecting the diagram shows that the pulleys driving the countershafts are not close together. By reversing each opposite pair of countershafts, end for end, their driving pulleys come close together, and their belt pulls on the main shaft now partly balance one another. Again, by doubling the speed of the main shaft and halving the pulley diameter the load on the main bearings is reduced at the expense, however, of the friction velocity and the result is a loss. Such a change is unprofitable. It does not pay to reduce the 3¼-inch shaft to 2¼-inch with reduced belt pulleys. Speed the shaft up and keep the same pulleys and they can be made narrower, and smaller belts may be used having only one-half the pull. This reduces the load on all the shafts and only increases the friction on the main shaft. Starting with an original resistance of 1,584,615, the reversal of the countershafts reduced this to 1,191,575. The next change reduced it to 819,354. If, however, the main shaft had been kept down to 100, and the belt speed had been got up by enlarged pulleys the countershaft losses would remain as in the last case, but the main line friction speed would be reduced by more than

the load would be increased and the total resistance becomes now 720,543. The next trial is to increase the pulley diameters again all round and put the main shaft again up to 200 revolutions. The result all round is a saving and the total resistance becomes 558,162. But he now observes that the pull of opposite countershafts is uneven upon the main shaft, and he reduces the pulleys on one of them so as to get a balance. This reduces load and friction, for it transfers pull from a large to a small bearing at a lower speed. Having obtained the balance on the main shaft he then again increases pulley diameters in proportion, and gets up the belt speeds again, and obtains a final resistance of only 463,120, or less than a third of what he began with. The general deduction seems to be to balance pulls on a main shaft driving to two sides. To keep such opposite pulls upon closely contiguous pulleys. To keep shaft speeds low and pulley diameter high. It is, of course, the difficulty in practice, to get pulleys as large as one would like. There is not room for them. Designers also look to first cost of pulleys and are exceedingly apt to forget belts, yet where belts are long and good their cost may go a long way towards increased pulley cost. Belts can be narrowed as much as pulley diameters are increased, while the pulleys themselves may be narrower, and they will be easier for the belts and have better grip. Designers are apt rather to place pulleys close up to bearings, when they could do better if they placed them close up to an opposite pulling belt, and so saved bearing friction. It is not always that one finds the opportunity of using balancing pulls, and probably in the majority of cases the only savings are to be made with one-sided pulls. Experience with belt transmission at slow speeds compels one to seek after large pulleys and high speeds of belts, while avoiding unnecessary journal speed. It is obviously better to use frequent bearings than to enlarge a shaft to withstand a heavy side pull. Light shafts at high velocity have been fashionable, even to unnecessary reduction of pulleys. This should not be.

Electrical engineers are liable chiefly to consider shafting when reducing speeds from motors, and we think, for first reduction, they would often find it advantageous to use a rope or cord transmission. True, the bending of a rope is more difficult than to bend a flat belt of equal strength but this applies more chiefly to square ropes. The moment of inertia of a round rope is much less and its bending resistance is smaller than that of a rectangular belt of equal thickness. It is easier, however, to buy rim pulleys than flat pulleys. The near future should, however, find a place for light narrow belt pulleys with light arms suitable for electrical first reductions.

## BUSINESS NOTICES, &c.

### Electrical Wares Exported.

| Week Ending Aug. 23rd, 1897. | £ | s. | Week Ending Aug. 23rd, 1898 | £ | s. |
|---|---|---|---|---|---|
| Adelaide ... ... | 47 | 0 | Albany ... ... ... | 16 | 0 |
| Amsterdam ... ... | 70 | 0 | Amsterdam ... ... | 115 | 0 |
| Antwerp .. ... ... | 150 | 0 | Bangkok ... ... | 20 | 0 |
| Auckland ... ... | 285 | 0 | Boca ... ... ... | 37 | 0 |
| Bangkok. Teleg. mat. ... | 288 | 0 | Buenos Ayres ... ... | 193 | 0 |
| Boulogne ... ... | 160 | 0 | Calcutta ... ... ... | 121 | 0 |
| Buenos Ayres ... ... | 10 | 0 | Cape Town ... ... | 144 | 0 |
| ,, Teleg. mat. | 10 | 0 | Chinde .. ... ... | 941 | 0 |
| Calcutta ... ... | 664 | 0 | Christiansande ... ... | 16 | 0 |
| Cape Town ... ... | 352 | 0 | Copenhagen ... ... | 65 | 0 |
| Colombo... ... ... | 6 | 0 | Durban ... ... ... | 58 | 0 |
| Copenhagen ... ... | 6 | 0 | East London ... ... | 85 | 0 |
| Durban ... ... ... | 187 | 0 | Fremantle ... ... | 36 | 0 |
| ,, Teleg. mat. ... | 57 | 0 | Gibraltar ... ... | 600 | 0 |
| East London ... ... | 23 | 0 | Hamburg ... ... | 380 | 0 |
| Flushing ... ... | 70 | 0 | Launceston ... ... | 7 | 0 |
| Hamburg ... ... | 248 | 0 | Malta. Teleg. cable | 120,000 | 0 |
| Malaga ... ... ... | 75 | 0 | Melbourne ... ... | 588 | 0 |
| Melbourne .. ... | 35 | 0 | Ostend ... ... ... | 176 | 0 |
| Montreal ... ... | 500 | 0 | Perth. Teleg. cable ... | 664 | 0 |
| Novorossisk ... ... | 600 | 0 | Port Elizabeth ... ... | 1,517 | 0 |
| Port Elizabeth ... ... | 420 | 0 | Rangoon ... ... | 36 | 0 |
| Shanghai. Teleg. mat. | 34 | 0 | Stockholm. Teleg. wire | 125 | 0 |
| Singapore. Teleg. mat. | 12 | 0 | | | |
| Sydney ... ... ... | 500 | 0 | | | |
| Total | £4,808 | 0 | Total | £125,940 | 0 |

### Foreign Goods Transhipped.

| | £ | s. | | £ | s. |
|---|---|---|---|---|---|
| Calcutta ... ... ... | 420 | 0 | Melbourne ... ... | 89 | 0 |

**Adjudication Order.**—According to the *London Gazette*, an order was made at the Wandsworth Court in *re* Fredk. Jones, electrical engineer, (F. Jones & Co.), 147, St. John's Hill, New Wandsworth, on August 19th.

**A Hint.**—There is still one of the three shops recently built in Sun Street, Canterbury, to be let. It stands in one of the best parts of Canterbury, being opposite the ancient Christchurch Gate of Canterbury Cathedral, and in a good business neighbourhood. An enterprising firm of electrical engineers would do well if they established a branch in the ecclesiastical metropolis. The premises are well adapted for the business, and the municipal installation of electric lighting will cause a great demand for fittings, &c., which the tradesmen of Canterbury cannot possibly adequately meet.

**Annual Outing.**—The annual outing of the employés of the "Robertson" lamp factory took place on Saturday. The party, numbering considerably over 200, proceeded to Hastings, where a very pleasant day was spent.

**Canada and Trade Catalogues.**—It is announced in the *Times* that the following memorandum has been issued by the Minister of Customs to the Collectors of Customs in Canada, with reference to the admission through the post free of duty of British, colonial, and foreign catalogues and price lists:—"You are instructed that *bonâ fide* trade catalogues and price lists of goods for wholesale in any country beyond the limits of Canada, not exceeding three to one address, may be admitted through the mails free of Customs duty: Provided, however, that such catalogues and price lists shall not be held to include almanacs or advertising periodicals, or printed matter designed to advertise the sale of goods by any person in Canada."

**Change of Address.**—Messrs. Nastorg, Burt & Co., electric light fittings' makers, are about to remove from 182 to 123, Oxford Street, W.

**Exhibition.**—Mr. C. O. Bastian, of Westminster, has been exhibiting his shilling-in-the-slot meter at the Royal Cornwall Polytechnic Society.

**Fined.**—Wm. Gurney, stated to be in the employ of an electric motor car company, was fined 40s. on 18th inst. for driving a motor car at Brighton at an excessive rate of speed. The evidence put the rate at 14 or 16 and 17 or 18 miles an hour.

**Liquidation Notices.**—At meetings of the Crystal Electric Company, Limited, held on July 8th and 29th insts. at St. Stephen's Chambers, Telegraph Street, resolutions were passed approving of an agreement with Messrs. F. W. French and Murray Griffith for the sale of the assets and undertaking of the company. After the completion of the sale the company will wind up voluntarily, Mr. H. Lovegrove, of Dalmeny, Sutton, Surrey, being appointed liquidator for the purpose.

On September 6th, at 11.30 a.m. and 12 noon, respectively, the first meetings of creditors and contributories of the London Provincial Electrical Company, 110, Cannon Street, E.C., will be held at 33, Carey Street, W.C.

**Lists.**—The Safety Concentric Wiring Company, of 34, Victoria Street, S.W., send us an advance copy of a pamphlet in which they describe their system of electric wiring, and give illustrations showing the parts, as well as photos of public buildings, mills, shops, theatres, &c., where it is installed. The company's works are at 5 & 6, Bovay Street, Holloway.

An illustrated list of the "James" arc lamps has been issued by Messrs. H. V. James & Mills, of the Pendleton Electrical Works, Croft Street, Pendleton, Manchester. The list illustrates and particularises open and enclosed types of arc lamps for alternating and continuous current circuits. Prices are given.

The Chattanooga Machinery Company, of Chattanooga, Tenn., have issued a small but very neat and well illustrated pamphlet describing their insulator pin, bracket, and cross-arm machinery. An illustration shows a few of the typical ways of using cross-arms, side brackets, and insulator pins, and among the machines described are the standard pin machine, the pin and bracket threading machine, duplex horizontal boring machine, multi-spindle cross-arm borer, and self-feeding cross-arm rounding planer.

A gorgeously printed catalogue with highly-coloured covers has been brought out by the Improved Electric Glow Lamp Company, of Queen Victoria Street. The reports prepared by experts are printed, the various types of lamps and fittings described and illustrated, and views are shown of the company's stores, showrooms and offices.

**New Engineering Department.**—Messrs. Edwards and Barnes have opened a general engineering department at Broad Sanctuary Chambers, Westminster, S.W., and taken up as specialities the well-known "Berryman" feed-water heaters, circulating heaters, water softeners, filters, and all forms of condensing apparatus. Mr. Howard T. Wright, who was long associated with the development of the "Berryman" heater, &c., in connection with the late Patent Heater Condenser Company, Westminster, has been appointed manager of this department.

**The Glasgow Water-Tube Boiler.**—This new water-tube boiler consists of an upper steam drum and two lower water drums joined by four sets of small water tubes, so bent at each end as to enter their respective drums in a radial direction as in other water-tube boilers of the small tube variety. The two water drums are vertically behind the middle of the length of the steam drum and transverse to it, so that the front set of water-tubes is considerably inclined, the two back sets being nearly vertical. Firebrick partitions compel a zigzag course, and, as though the passage of the gases through the first nest of tubes were not sufficient to quench all desire for further combustion, some secondary air is admitted by means of a thin chamber in the first firebrick partition. With a chimney temperature of 630°, we observe that the boiler efficiency is given as 85 per cent., with a coal consumption of 31·5 lbs. per square foot per hour, and a $\frac{3}{8}$th inch water gauge. Apparently the grate surface was 71 square feet, and it is stated that with these conditions and some secondary air, combustion was smokeless, but we see only one reason why this should be so, namely, the front half of the fire is covered with a firebrick arch, while against the probability of this being regularly attained, is the fact that the gases rise direct from the back half of the fire amongst the tubes. We do not think a long flaming bituminous coal would be burned smokelessly in this boiler.

**New form of Post Office Wheatstone Bridge.**—The well-known form of bridge commonly known as the "Post Office" pattern has been used practically in its present form for the last 25 years. The fact that the pattern has retained its place for so long is a proof that it is a form of instrument which is extremely useful for a wide range of work, and also satisfactory in its working. A few decided improvements have been made in certain details from time to time, but it may fairly be admitted that with all the advantages of the old arrangement there are points in which it might be still further improved; the defects are not numerous, but they are distinctly disadvantageous. Messrs. Nalder have recently brought out a new form in which the advantages are all retained and the defects found in practical use are removed. The plugs in the old form are very much crowded, and the blocks rather small. In the

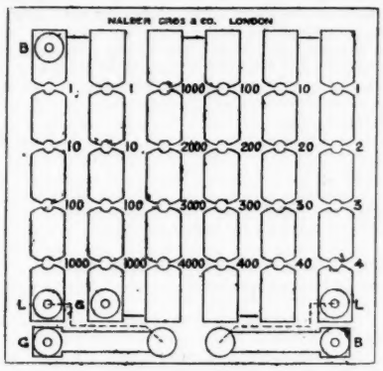



Fig. 1.

new form the plugs are spaced wider apart, so that they are quite easy to manipulate; the size of the blocks is also increased, thus diminishing block resistance error. These advantages are not obtained at the expense of size or weight. The new form of box is a little broader and longer than the old, but the depth is, by the use of a new and improved form of coil, reduced, the cubical contents and the weight remaining practically constant. The old pattern is troublesome to read without considerable practice, the figure against each hole unplugged has to be looked at, and as the blocks are much crowded, it is not easy to see the figures, especially in a bad light, and when the paint filling of the figures has become dull. In the new form the units, tens, hundreds, and thousands are arranged in four separate bars as in fig. 1. The figures are more easy to see, but are hardly required after a very little practice, as each decimal

Fig. 2.

having its own bar, the reading is obvious to the eye in the dullest light without looking at the figures. The old form was troublesome to clean. In the new one the bars are joined underneath so as to give a clear way through between each two. For convenience the underneath junctions are marked on the upper side by white lines. Another advantage is an extra pair of ratios, 1, 10, 100, 1,000, instead of 10, 100, and 1,000, thus increasing the range 10 fold each way. The keys and terminals remain as before, allowing the bridge to be used as a potentiometer, double shunt, &c., as previously. It must be remarked, however, that the new pattern is not provided with a reversing switch, which is a most necessary adjunct, and which Messrs. Nalder would be well advised to add. Fig. 2 shows the new pattern bridge in general view.

**Sale by Auction.**—Messrs. Fuller, Horsey, Sons and Cassell are to sell by auction on Thursday, September 1st, a large quantity of electrical engineer's tools at the Tower Bridge Electrical Works, Sard's Rents, Bermondsey. For particulars see our "Official Notices" this week.

**The Pollak Accumulator.**—Mr. W. C. Horne, of 5, Torrens Street, City Road, E.C., has been appointed sole agent in England for the Pollak accumulator, which is manufactured by Accumulatoren Werke System Pollak, of Frankfort-on-Main. He has a 250-ampere-hour battery at work at his showroom for inspection. We have received a very nicely arranged and well illustrated list in which the Pollak cells are described in considerable detail. There are a number of good photographic views of Pollak battery plants which have been erected in various Continental towns. One section of the book is devoted to the use of these batteries in traction work, views being shown of the Frankfort cars. Further illustrations and details describe the Frankfort manufactory.

**The Smoke Nuisance.**—On Friday last at Marlborough Street, the summons taken out against the Metropolitan Electric Supply Company, Limited, for causing a nuisance by allowing black smoke to be emitted from their chimney in Black Horse Yard, Rathbone Place; for using furnaces so constructed as not to consume their own smoke; and for using the furnaces negligently so that the smoke was not consumed, was further heard. The defence set up was that, owing to the Welsh coal strike, the company could not help what had occurred. The case was adjourned so that the magistrate should consider the point raised and give his decision upon it. Mr. Hannay, in giving his decision, said it was argued for the defendants that, as by the provisional order of 1889 they were obliged to supply persons requiring it with the electric light, they could not be prosecuted for merely doing that which they were authorised and obliged to do under penalties. It would be strange, indeed, however, if Parliament had authorised private companies for their own advantage to poison the air of the metropolis, and, as was pointed out, section 83 of the order of 1889 expressly stated: "Nothing in this order shall exonerate the undertakers from any indictment, action, or other proceeding for nuisance in the event of any nuisance being caused by them." He had no hesitation in saying that it was monstrous to urge, as had been urged in effect before him and other magistrates, that the metropolis of this country must continue smothered in smoke until the Welsh miners and their employers had settled their differences. His past experiences convinced him that the smoke nuisance could be kept within reasonable bounds if the authorities only did their duty. It might cost the manufacturers something more to have their furnaces properly constructed and well attended to, but that was as nothing compared with the injury and damage caused to the general public by the reckless fouling of air which had been going on unchecked. Under the circumstances he should impose the full penalty of £10. Mr. Hannay declined to state a case, remarking that no legal point had been raised. The Vestry were allowed five guineas as costs.

**Water-Power Utilisation in Sweden.**—A proposal is under consideration to put down plant to utilise the power of the Dal Elf waterfalls, near Karleby Elf, in the generation of electrical energy, and to transmit the same to Stockholm, a distance of about 160 kilometres.

**Williamson & Joseph, Limited.**—This firm, whose factory was recently purchased by the L.C.C. under compulsory powers, announces that it has acquired the Northampton Works, Northampton Grove, Canonbury, and has equipped them with the most modern machinery and plant for the manufacture of electrical work. On and after September 25th, the warehouse and office portion of the business will be conducted from these new works. The stock will be sold at a sacrifice to save the expense of removal.

**W. T. Glover & Co., Limited.**—This well-known firm has issued an excellent catalogue of its manufactures. By means of a convenient thumb index, it is easy to get at whatever section is required. As might be expected, the book consists for the most part of table matter, such tables showing, among other things, the following:—Dimensions, capacity, resistance, and weight of conductors; particulars and prices of vulcanised wires and cables, braided; lead covered vulcanised ditto.; armouring and braiding; Board of Trade cables; vulcanised concentric; diatrine cables; pure rubber insulated electric light wires, aerial cables. Other tables give data *re* flexibles, concentric wiring, cotton and silk lapped wires, solid sectional copper and armature material. This information is supplemented by useful matter in the form of conversion tables, comparative table of equivalent conductors, resistances of different metals. A number of sheets are set apart for notes at the end of the book. The catalogue is about as neat as anything of its kind we have seen. Its size, 5 inches by 7 inches, makes it convenient for the breastpocket.

## ELECTRIC LIGHTING NOTES.

**Aberdeen.**—Mr. J. A. Bell, the newly-appointed electrical engineer, was formally installed in office on 18th inst.

**Barking.**—Some members of the Lighting Committee visited Brighton some days ago for the purpose of inspecting the electric lighting of that town, and deciding upon the merits of the several incandescent lamps submitted to them by the firm who hold the contract for supplying the lamps for Barking. The Committee were met at Brighton by a representative of the Reason Manufacturing Company, and taken to the electric lighting station, where Mr. Wright personally conducted them over the works.

**Bath.**—At a meeting of the Baths Committee last week held to consider tenders for putting up an electrolier in the Grand Pump Room, it was stated that only Messrs. Veritys (London), and Messrs. Singer (Frome), had been invited to tender. It was decided to accept Messrs. Singer's tender for a bronze 100-light electrolier, the price being £100, not including lamps and holders.

**Belfast.**—At the last meeting of the Harbour Board, Mr. Greenhill said he had reason to know that a very strong desire existed that the electric light installation, especially for the York Dock, should be completed before winter, and he asked when that work would be completed. Mr. G. F. L. Giles (engineer) said the temporary arrangement for using the current from the County Down side in the York Dock would be completed by about November 1st.

Preparations are now being made for the formal opening of the new electric light station at the Albert Bridge, which will be performed by Earl Cadogan, K.G., Lord Lieutenant of Ireland. The actual date of the ceremony has not yet been fixed, but it will take place about October 18th.

**Brighton.**—The Lighting Committee have resolved that an electricity main be laid in Harrington Road at a cost of £150; in Elm Grove from the west end to Bonchurch Road, and in Bonchurch Road at a cost of £275; and that the 14 street lamps on the route of the mains be lighted by electricity instead of gas.

**Buenos Ayres.**—The *South American Journal* says that there was talk at Buenos Ayres recently of a fusion of the Old Gas and the Allgemeine Electric Light Companies. The business had been kept very quiet. The transaction solely relates, however, to the electric section of the Allgemeine Company.

**Cape Colony.**—A South African journal says that East London is again within measurable distance of being provided out-and-out with a full scheme of electric light and trams. The Town Council met specially on July 26th to open tenders received. Altogether 13 tenders were opened, of which six were from England. Mr. R. L. Cousins, of Johannesburg, the Council's consulting electrical engineer, has been communicated with, and tenders will be referred to him and the Town Engineer for report as soon as he arrives.

**Crewe.**—The provisional order applied for by the Crewe Town Council to provide a generating station and to supply the borough with electric light has been granted. The cost of the scheme is estimated at about £25,000. Dr. Hopkinson has been consulted, and has advised the Corporation of a suitable site for the works.

**Crieff.**—Some time ago Sir Patrick Keith Murray, of Ochtertyre, offered the use of the water-power of the Falls of Barvick and Turret (some three miles north-west of the town) to the Crieff Town Council for the purpose of utilising it for generating electric light for the town. A report was got by the Council from Mr. Arnot, late electrician to Glasgow Corporation, who reported unfavourably with regard to the proposed scheme. Later, says a Glasgow paper, Mr. R. F. Yorke, Glasgow, offered to undertake a scheme of producing electric light by utilising the waterfalls; but after much discussion the scheme has apparently been abandoned by the Town Council, and now Sir Patrick, having been approached by Dr. Meikle, managing director of the Strathearn Hydropathic Company, has given the doctor leave to make preliminary surveys, &c., in Corrie Barvick, with the view of utilising the water-power for electric lighting purposes in the hydropathic establishment.

**Cromer.**—A Committee recently reported as to the electric lighting question, and the Council has decided to instruct the surveyor to prepare the necessary plans and scheme, and report to a future meeting.

**Electric Light at Marlborough House.**—Arrangements have been made for the placing of a number of electric arc lamps in the forecourt and stable yard at Marlborough House, which are at present very indifferently lighted. It is hoped to have the installation completed before any members of the Prince of Wales's family resume residence. Workmen on Tuesday commenced making the trenches for the main from which the arc lamps will obtain their supply.

**Glasgow.**—At the last meeting of the Corporation, Bailie Maclay, in moving the approval of the minutes of the Electricity Committee, stated that they were now making rapid progress with the new works at Port Dundas. He was happy to say that all the plant, engines, and dynamos under order were likely to be completed within the contract time. Their difficulty would now be in hurrying on the erection of the works to receive the plant. As regards the new works in Pollokshaw's Road, they hoped to begin operations there at a very early date.

**Greenock.**—Last week the Police Board considered the proposed erection of an electric lighting station. The minutes of the Law and Finance Committee contained the report of the deputation appointed by the Electric Lighting Committee to visit various towns in connection with the proposed electric lighting. The deputation visited Edinburgh, Leith, and Glasgow, inspected the electric light stations, and after carefully considering the information obtained and the advice given, they recommended that the Board should appoint a resident engineer who should prepare a design of the works and report thereon and on the area of supply. The sub-committee also considered the terms of the notice from the North British Electricity Supply Company, Limited, and recommended that the company should be informed that the Board would oppose their application for a provisional order to supply electricity in Greenock, as the Board was taking active steps to introduce the electric light. The report was adopted.

**Grimsby.**—The Public Lighting Committee of the Town Council met last Friday to receive and consider Prof. Kennedy's report on electric lighting and tramways for the borough. The Chairman (Alderman Dobson) said it might be thought that the Sub-committee had been rather a long time in getting the report out, but he could assure the Committee they had been very busy all the time, first with Prof. Kennedy, and then with the tramway company, with whom they had had several interviews. So far as the tramway company was concerned, they would see from the copies of the report that had been distributed, that the company was prepared to receive current from the Corporation on certain conditions. There had been a good deal of negotiation, but the Sub-committee were unanimously of opinion that they had struck a very fair bargain with the tramway company. With that company as a customer, the Corporation would be able to keep up a day load as well as a night load, which would have very great advantages. As to difficulties—well, there were no real difficulties in the way. Prof. Kennedy said that, so far as Grimsby was concerned, he did not see any difficulty whatever in carrying out the scheme. This scheme, they were told, would be a source of revenue to the town in a very short time, and he was sure it would be a source of comfort to the inhabitants. As to the tramways, it was very fortunate that the matter came up at this juncture, when the tramlines had to be relaid. So far as the estimate went, at the very outside it would be £40,000. They had put it to Prof. Kennedy very closely as to whether the £40,000 would cover the whole of the cost; Prof. Kennedy was a very safe man, and he told them that the scheme might cost less, but £40,000 would fully do all they wished to do. He urged that electric lighting was certain to come, and that it would be far better for the Corporation to go in for it now than have to pay large sums for its purchase, for arbitration, &c. He reiterated that there were no difficulties in the way, and that no town was better prepared for the electric light than was Grimsby.

After very lengthy discussion, the sub-committee's report was adopted.

In their report the sub-committee explained that the tramway company were first approached, consultations took place, and certain conditions were agreed to. These conditions state that the company on making their line an electric traction shall purchase the power from the Corporation at the rate of three half-pence per Board of Trade unit for the first 360,000 units used, and to guarantee to take a minimum of 360,000 units per annum; above 360,000 and up to 460,000 units the charge to be at the rate of one and three-eighths pence per unit, and all above 460,000 units to be charged at the rate of one penny farthing per unit. The tramway company are to reconstruct the present lines, to double them from the depôt to the Old King's Head in Victoria Street, and to construct an additional loop line from the latter place *viâ* George Street and Osborne Street to the White Hart Hotel. Moreover, the tramway company are to run a seven and a half minutes' service from April 1st to October 31st, and a 10 minutes' service during the remainder of the year, and to institute a system of universal penny fare within the borough. Of course the tramway company would require an extension of lease. Prof. Kennedy's letter, prefacing his report, stated that he had been also asked to consider the question of dock lighting. He had not gone into this in the report, but he roughly estimated that to light the offices and sheds thoroughly they would require from 150,000 to 200,000 units per annum, that was supposing in most cases the sheds were used all night. He considered it would not be worth the while of the Corporation to supply the electricity.

In his report, Prof. Kennedy stated at the outset that from a somewhat large experience in connection with municipal enterprises of this kind he was able to say with confidence that a well-conducted municipal electrical undertaking might now be considered as certain of success, both from the technical and financial point of view. This was the case even where it was only proposed to supply current for lighting purposes; whereas in Grimsby they also expected to be able to supply current to the tramway company for power, therefore success was still more certain, and they would be able, sooner than was often the case, to reduce the price of current to customers.

After considering the area to be supplied, he advised the use of a continuous current three-wire system, with lamp running at about 230 volts. This system would, without any alteration, enable them to supply current to any part of the borough, and also enable them so to arrange the machines in the station that they would be available either for power or lighting, so that the reserve plant would do for either purpose, and in this way they would save considerably in capital cost, as well as effect a convenience of working. He recommends as a site Corporation property just to the north of the Old Cemetery, to which a siding could be had from the Great Northern Railway.

They might assume that within a year or two of the opening of the station they would have a total of about 9,000 lamps of 8-candle-power for their equivalent connected to the mains; but of these not more that 5,000 would be alight at once. In his estimate he had provided for plant which would be sufficient to keep 5,000 lamps alight at once. The 9,000 lamps would require altogether about 135,000 units per annum. The total power of the plant to be put down in the station, including reserves, would be about 750 H.P. Separate mains would be required for the tramlines.

On general grounds it would be found universally that it was both advisable and profitable policy for a municipality which owned its own electric light works to undertake some substantial amount of public lighting. This would especially be the case in Grimsby, as they could afford to supply public lamps (considering the nature and continuance of their ordinary load) at a price lower than that often reached. The route suggested would be lit up by about 50 lamps of ordinary power nominally 1,000 C.P. each.

He understood that at some later period it might be considered desirable to put up a refuse destructor somewhere near the electric

light station. If this were to be done, there would be no difficulty at all in making the electric lighting chimney large enough to serve also as the chimney for the destructor when the latter was at work. Nor would there be any difficulty in arranging so that the waste heat from the destructor should be used—for what it was worth—to assist in generating steam for the electric lighting station. The value of this assistance was often over estimated, nevertheless it was a thing that should not be neglected, and of which they should certainly take advantage if the Corporation later on decided upon the erection of a destructor. The details of the estimate, which totalled £35,000, but in view of contingencies of slight alterations and extensions which might be thought desirable, it was advised that the sum applied for as probable capital expenditure should be £40,000. Plans were attached to the report of the routes and of the proposed station.

**Haslingden.**—The Town Council has adopted the Lighting Committee's recommendation to select a site at the Town's Yard for the purpose of electric lighting works. The suggested area of supply has been also approved, and an electrical engineer will be engaged to advise upon the several matters connected with the application for a provisional order. The Council will, of course, oppose the application for powers proposed to be made by the Electrical Power Distribution Company.

**Horsham.**—The Urban Council on Friday decided to apply to the Board of Trade for a provisional order authorising the Council to undertake the electric light supply of the town, in accordance with the report and estimate prepared by Mr. Hawtayne.

**Hospital Lighting.**—On Friday evening last Mr. F. H. Cheetham, J.P., president, visited the Taunton and Somerset Hospital for the purpose of switching on the electric light to the Hospital and Nursing Institute. The installation has been carried out by the National Free Wiring Company, London, from a specification drawn up by Mr. E. B. Thornhill, the borough electrical engineer, at a cost of about £150, and in every particular it is of a complete and highly satisfactory character. The Hospital and Institute have been fitted throughout with 157 lamps, which will be supplied with current at a pressure of 100 volts, the current being derived from the Corporation mains. The three-wire system of distribution is employed, with 200 volts between the outside conductors.

**Kenmare.**—The scheme which not long since was set on foot for the electric lighting of Kenmare is stated to have been abandoned, owing to the fact that in dry seasons the water-power is quite insufficient to work the dynamo. It is also stated that the proprietors of the Electric Light Company intend to erect a steam engine, which would act as a rebate in dry seasons when the water-power is low.

**Kingston.**—The Board of Guardians is making inquiries of the Kingston Town Council as to the terms upon which they would be prepared to supply electric current to the whole Workhouse buildings. The architect has been instructed to prepare a scheme providing the necessary power for generating the supply, in order that a comparison might be made between the Corporation charges and the maintenance and expenses of an independent installation.

**Kirkcaldy.**—The electric lighting and tramway movement has been taken up in earnest by a number of leading commercial gentlemen in the town, headed by Provost Hutchinson. The Corporation, however, have been offered to promote the scheme, but they have taken till September to consider the matter. Should the town refuse to undertake the promotion of the scheme, this private local company will do so. Several London companies have now given notice to the Corporation to apply for an order to introduce electric lighting into Kirkcaldy, but the popular opinion is that, should the Corporation not undertake the scheme, they should throw in their support with the local company, which is composed of Mr. John Barry, ex-M.P., Mr. M. B. Nairn, Mr. A. H. McIntosh, and other leading men in the burgh. Prof. Kennedy has reported favourably on the scheme. The original scheme was to have the electric tramway run from Dysart to Linktown by way of Kirkcaldy station, being a distance of some six miles. That route has now been modified, and the Dysart section cut off. Meantime, the Corporation's decision is awaited with interest.

**Lanchester.**—At a recent meeting of the Board of Guardians, the question of lighting the two infirmaries and the Union Buildings with the electric light was considered. It was pointed out that to light up the whole of the buildings a large installation would be required. It was decided to invite tenders from three of the largest electric firms in the north of England, so as to ascertain the cost of an installation. A committee was appointed to go into the question and report. The chairman pointed out if the committee thought that three tenders would not be sufficient, they could go further afield, and invite the London firms to compete.

**Llandudno.**—The Local Government Board has sanctioned the borrowing of sums amounting to £25,000 for electric lighting.

**Leeds.**—The Electricity Sub-committee of the Parliamentary Committee of the Leeds Corporation was to meet some of the directors of the Yorkshire House-to-House Electricity Company this week to discuss various matters of detail relating to the transfer.

**Lewes.**—On Friday last Mr. Warden-Stevens attended a special meeting of the Corporation to receive further instructions in connection with the electric lighting.

**Mauritius.**—The scheme for the electric lighting of Port Louis, recently prepared by Mr. F. J. Warden-Stevens, is to be placed before the municipality, and it is expected that the works will be commenced without delay. Mr. Warden-Stevens has since received instructions to prepare a scheme of electric tramways for the city.

**Monifieth.**—The proprietors of Monifieth Foundry are making preparations for the introduction of an extended system of electric lighting in their works and dwelling houses. Three engines and two boilers are to be put down for general purposes as well as driving dynamos. Electricity is already largely used for lighting and power purposes at the foundry.

**Monmouth.**—Messrs. Siemens are pushing forward the laying of the electric light cables. Monk Street is already laid, and part of Whitecross Street. The electric lighting plant at the Forge is being rapidly put together, and before the winter commences it is calculated the streets will be lighted electrically.

**Morecambe.**—The work of installation proceeds more satisfactorily at Morecambe than it did a few months ago. Mr. Parkinson, the engineer, has been authorised to procure an overhead traveller for Victoria Street sub-station, and 50 electricity meters from Messrs. Venner & Co. It has been decided to erect 25 additional arc lamps on the Victoria Esplanade. The promenade will then be lighted for two miles. Mr. Parkinson has visited the works of the Callender Cable Construction Company at Erith, and reports that his tests of the high pressure concentric and single conductor cable were very satisfactory. The Public Works Loan Board have resolved to grant a loan of £8,821 applied for, to be repayable with interest at the rate of 2¾ per cent. in 30 years.

**Newbury.**—The Corporation spent several hours last week discussing the comparative merits of gas and electricity. Notice had been given by the Great Western Electric Light and Power Company and the United Electric Light and Power Company, of their intention to apply for provisional orders to supply the town, and Mr. Offor, of the Municipal Electric Supply Company, proposed to purchase the provisional order obtained eight years ago by the Corpo ation, paying all the expenses which had been incurred, taking over the lighting of the town, and the option of purchase by the Corporation at the end of 10 years, plus 6s. 8d. in the £. The charge suggested was £2 10s. to £3 10s. for public lamps, and private consumers at 2d. per unit after the first hour at 8d., equal to 2s. per 1,000 feet of gas. The price in Newbury is now 4s. 2d. per 1,000, and the Corporation are the owners of the gas works. The Gas Committee recommended the Council to decline the offer and to instruct the Town Clerk to oppose all applications for power to supply electricity. The general opinion seemed to be that it would be suicidal to allow an electric lighting company to come as a competitor with the gas, although it was argued that electricity was much dearer, and that it could not be supplied at the price named. The Mayor considered that if they could get for 2s. what now cost them 4s., it was their duty to get it. The Council obtained their order eight years ago, and no steps have been taken to carry out its conditions, the reply being that no one has ever applied for electricity. It was, however, realised that if half a dozen burgesses did make application they must supply it, or allow someone else to do it. The Council adopted the Committee's recommendation.

**Newton Abbott.**—At last week's District Council meeting, the Lighting Committee reported having considered letters with reference to the proposal of Edmundsons' Electricity Corporation, Limited, to apply for a provisional order. The Council will obtain a copy of the General Power Distributing Company's Bill now before Parliament. A meeting will be held later to consider the matter further. Mr. Warden-Stevens has written offering to prepare a preliminary report on electric lighting.

**Paris.**—The illumination of the Bois de Boulogne at night will, according to the *Galignani Messenger*, ere long be an accomplished fact. The plans have been concluded, and, according to present arrangements, the following main arteries will be lit by powerful arc lamps:—1. The long avenue from the Porte Maillot to Suresnes Bridge by way of the Allée de Longchamp, with ramifications running from the Allée to the end of the lakes, and from there to the Porte Dauphine. 2. Round the lakes and round the green swards known as the pelouses de la Muette. 3. The Avenue of the Hippodrome from the lakes to the Longchamp Course, and that part of the Reine Marguerite Road comprised between the Allée de Longchamp and the Hippodrome Road.

**Peterborough.**—The foundations for the Corporation electricity works are being prepared by a gang of men under the supervision of Mr. J. C. Gill, the borough electrical engineer.

**Pwllheli.**—The Town Council has resolved to consider at a further meeting the advisability of lighting the town by means of electricity rather than gas.

**Portugal.**—The *Consular Journal* says that the French have obtained a concession for lighting the town of Lourenço Marques with electricity.

**Plymouth.**—It is reported that the municipal electricity works will be sufficiently advanced by September 13th to permit of the George Street Baptist Chapel being lighted by electricity.

**Portsmouth.**—The auditors, in their report to the Electric Lighting Committee, say that the profits for the year admit of the provision thereout of the instalment of principal and interest, and the extinction of the deficit shown in last year's account, leaving a small balance of £383 12s. 7d. to be carried forward. "We again direct attention to the fact that no provision has been made for depreciation of plant and machinery, whilst the re-payment of principal might, if adequate, be considered in the light of depreciation; yet it is possible, owing to the length of some of the loans, that portion of the plant and machinery will have practically ceased to exist before the repayments are completed. The question of the division of expenditure between capital and revenue is one deserving of the special consideration of the committee. There are numerous small accounts for materials, which manifestly might be used either for new work or repairs, and we are not absolutely satisfied that there is no possibility of error being made in charging to capital instead of revenue account."

**Rugby.**—At last week's District Council meeting a letter was read from Edmundsons' Electricity Corporation, stating that they understood that the Council had decided to obtain an order for electric lighting, and then to lease their powers to some company if necessary. They expressed willingness to take such transfer instead of getting an order direct. Referred to the General Purposes Committee. Mr. Seabroke formally gave notice that on that day six weeks he should move a resolution to the effect that the Council take certain steps for obtaining a provisional order as to public lighting.

**Shoreditch.**—To the 67 arc lamps already fixed in the public streets, 84 new ones are now being erected for use during the coming winter. The effect of this will be that all the main thoroughfares of the parish, with three important exceptions—Paul Street, Leonard Street, and Goldsmith's Row—will have the benefit of the electric light.

**Stoke Newington.**—For some time past the Vestry has carefully guarded its provisional order, and objected to companies coming in to carry out the work. It has just replied to the Metropolitan Electric Supply Company, and the County of London and Brush Company, that it is taking steps to exercise its powers, and will oppose all comers.

**Whitechapel.**—The Whitechapel District Board of Works have received a letter from Mr. Lawson, the engineer and manager of the County of London and Brush Provincial Electric Lighting Company, Limited, intimating that the company had reduced their price of current for private lighting as from July 1st last. This letter was read at the meeting of the Board on Monday, Mr. R. J. Chillingworth presiding. The letter was referred to the Electric Light Committee. The Board is having the George Yard site prepared for the erection of electricity works.

**Wycombe.**—The Free Library Committee has considered an estimate from the High Wycombe Electric Light Company for wiring and fitting up the Library with electric light, but has resolved that advertisements be issued for tenders for the wiring and fittings. The Council has approved of this. The Electric Lighting Committee have considered patterns and price lists of lamp columns and lanterns which will be required for the additional lamps to be erected, and have approved the pattern column submitted by the Electric Lighting Company, at a cost of 37s. 6d. each, and lanterns at 20s. each, and given the order for the number required. The Committee have considered a letter from Messrs. Hodges & Todd, desiring that Mr. Yeatman should be allowed to take up the position occupied by them as consulting engineers on behalf of the authority, but the Committee have instructed the Town Clerk to inform Messrs. Hodges & Todd that the authority would prefer that they should complete their engagement.

## ELECTRIC TRACTION AND MOTIVE POWER NOTES.

**Belfast.**—At the meeting of the Belfast Tramways Company on 16th inst., the chairman, after referring to the general business, proceeded to deal with the electric traction question. He said that they had been in communication with the Corporation for months and months, and, in fact, they had the subject before them at nearly every half-yearly meeting for some time past. Up to the present they had not been able to come to terms with the Corporation. The company made the Corporation a very good offer and a very liberal offer, as they thought, but they did not see their way to accept it. The Corporation had made a counter proposal, which he did not see his way personally to be able to fathom. All that he could say was, that he did not think it was one that the directors could possibly advise the shareholders to accept. The point for them was, that if they were to do anything, they ought to do it quickly and have done with it. If the Corporation wished to purchase on fair mercantile terms, they were quite willing to entertain a proposal in the interest of the shareholders. They thought the Corporation could easily do that, and make a good thing out of it. They could get electricity into Belfast on very easy terms, and terms that would satisfy the public who wished it. There was this in it, that the Corporation would have to pay a reasonable figure, and the company would have to accept a reasonable price—that was, what they considered a fair price. They would not have to sell at 19s. for the £, but they would have to get their full value as had been the case with other corporations which were quite as enlightened and quite as respectable as Belfast was—as, for example, Liverpool, Dundee, and Nottingham Corporations, which had bought out their companies before the time had expired, and on terms satisfactory to themselves and the shareholders. He did not think Belfast would expect to be treated any differently. It was a business transaction. There was no feeling in it one way or the other. For a long time they had held on to their concern, and unless they got something like an extension of the time or sold out, he did not think there was any way of dealing with the matter at present.

**Bradford.**—At a meeting of the Gas and Electricity Supply Committee last week, it was stated that during the previous week upwards of two miles of overhead trolley wire had been erected over the Great Horton section of the electric tramway, now rapidly approaching completion, and that formal application had been sent to the Board of Trade for the usual inspection to be made.

**Corea.**—A Toronto paper says that the City of Seoul, in Corea, with about 500,000 population, is to make a sudden change from the covered sedan chairs, which have been carried in its streets for 4,000 years, to a fully equipped electric railway.

**Dover.**—Mr. H. E. Stilgoe, borough engineer of Dover, has written to the *Daily Chronicle* stating that the average daily takings on the electric tramways are now £43, or 1s. 4d. per car mile.

**Glasgow.**—The Tramways Committee of Glasgow Corporation have been in conference with Lanarkshire and Renfrewshire representatives on the question of extending the tramway system to Cambuslang and Rutherglen and to Paisley. It is understood that the proposals made by the Committee have been favourably entertained.

**Huddersfield.**—At last week's Town Council meeting it was resolved to make an application to the Board of Trade for sanction to the borrowing of £7,454 for the construction of the Outlane tramway, and that the Board be asked to fix the period of 30 years for the repayment of the money. It was also suggested that the manager take the necessary steps for obtaining the rolling stock for the construction of the said tramway, and that he proceed with the construction.—In reply to Mr. Gee, Alderman Haigh, the chairman of the Tramways Committee, said it had not yet been decided to proceed with electric traction on the tramways. A great deal depended on the arrangement they made with the Linthwaite Council as to whether they took charge of the running over their lines. Should the Huddersfield Corporation decide to do so, then it would be for the Council to decide as to whether electric traction should be adopted.

**Johnstone.**—The report of the deputation which visited Continental towns to see electric trams in operation, concludes with the following:—"In conclusion, the Commissioners cannot help feeling that if the new tramway systems proposed round Paisley and Johnstone are to be as well equipped and worked as those at Havre, or still better, Rouen, then they, in common with all the inhabitants of the district, ought to give these proposals their heartiest support and approval."

**Lisbon.**—After prolonged negotiations, says a financial daily, the Companhia Carris de Ferro de Lisbon has obtained a concession from the Government and the local authorities for the introduction of electric traction on the Lisbon tramways. The concession is for 99 years, and the local authorities have reserved the right of requiring alterations in the system of working at the expiration of 20 years. The plans have already been prepared by the General Electricity Company, of Berlin, and that company, in common with Messrs. Wernher, Beit & Co., of London, are interested in the bringing of the project to a practical issue.

**Liverpool.**—The Corporation Tramways Committee have adopted the following resolution:—"That the Council be recommended to authorise the committee to take steps to have plans, sections, and estimates prepared to continue the Overhead Electric Traction Tramways from the termination of the experimental line at the Dingle to the end of Aigburth Road, and also for an extension of the experimental line from the Prince's Park Gates along Croxteth Road to Lodge Lane, in accordance with the lines as authorised by the Tramways Provisional Order of this session."

**Manchester.**—The Lord Mayor has convened a meeting of Manchester ratepayers for September 6th, to adopt resolutions in reference to the promotion by the City Council of a Bill to enable the Corporation to work tramways in the districts adjoining the city, and to authorise the making of agreements with local authorities for the working of the tramways by animal, mechanical, or other power.

**Margate and Ramsgate.**—This light electric railway scheme, to which we referred last week as having been sanctioned by the Board of Trade, will run from Margate jetty by Cliftonville, St. Peter's, and Broadstairs, to the front at Ramsgate. Mr. W. M. Murphy applied for powers so far back as November, 1896, but at the inquiry held before the Light Railway Commissioners in May, 1897, opposition was offered by all the local authorities. The Commissioners adjourned the inquiry indefinitely, in order to see whether terms could be arranged, and after negotiation, Mr. Murphy was able to enter into agreements with all the authorities. The Commissioners then sent the order on to the Board of Trade for confirmation, but further delay was caused by the opposition of a landowner, with whom, however, Mr. Murphy at length came to terms after prolonged negotiations. Messrs. Kincaid, Waller & Manville are Mr. Murphy's engineers for the scheme.

**Newcastle-on-Tyne.**—The *Newcastle Daily Leader* summarises the tramway situation at Newcastle, in connection with the two expert reports on cable and electric traction, in the following statement:—"Two of the best guides possible, it may be taken, have been sent in to the Newcastle Corporation to help it in deciding upon the new tramway service or services for the city, and with despatch there is no reason why a determination should not be so arrived at as would enable plans to be deposited with a view to an application to Parliament for powers next year. The new tramway movement is well enough known by the inhabitants of Newcastle—how Councillor Hugh Morton, moved by the difficulties and dangers of the Arthur's Hill horse trams, obtained a hearty support for mechanical traction by cable, how the lessees objected to work one line in this way, and how it was finally proposed to cover the whole system. The scheme was defeated in a ballot of the citizens, the the majority being partly in antagonism to the cable, partly against the total exclusion of electricity, and largely against the 21 years' lease to private parties, notwithstanding the favourable offer and guarantee given by the latter. The lessees being in occupation held a strong position; that occupation will end in November next year, so that the Corporation may be said now to have a free hand. From their present experience, what the citizens most desire is a better and more reasonable service, with as much expedition as the importance of the matter will permit. The question of lessees will be out of the way, so the Corporation may lay down the system or systems adopted as was intended; and work them, too, if that is thought to be the wisest in all the circumstances. After a careful consideration of the subjoined reports people may feel like the tuneful lover, 'How happy could I be with either were t'other dear charmer away'; while the expediency of having the cables for the hilly west end section and the overhead illuminated electrical system for the rest of the city, may be the readiest solution for those having to decide. Both experts declare that either system is available for the whole of the 20 miles of streets to be trammed, making 40 miles of single track. Both gentlemen have been chosen as being independent of any company concern, while each has had the best experience as engineer in the laying down of the respective systems. Dr. J. Hopkinson, of London, has supervised the electric tramway system for the Corporation of Leeds, and also in Liverpool. Mr. W. M. Colam has superintended the cable tramways now laid down by the Corporation of Edinburgh. The initial cost of the cable is much more than the other; but the maximum estimate for working the electric cars is 5d. per mile, while that for the cables is put at 3d. The electric power station would find the very best possible situation on vacant ground belonging to the city at the Manors, that suggested for the cables is a place that would have to be acquired between Clayton Street and Grainger Street, probably the Market, though it is pointed out that lettable buildings could be erected over the machinery in the basement, and the necessity for a chimney be avoided by mechanical draught, a practice, however, hitherto resisted by the Corporation. Dr. Hopkinson says nothing about profits; but points to the economical use of the electric power for arc lamps and quay cranes and haulage. Mr. Colam says that in Birmingham the profit made by the cable in that city is £3,830 per mile of single track per annum; in Newcastle, with an exceptionally low receipt of 6d. per mile, he estimates a profit of £1,861 per mile of track, which, as may be figured out in a moment, on 40 miles, would mean an annual gross profit of £74,440! The total estimated cost for construction and equipment by this system is £452,080; for the electric, £358,877 14s. 6d. For both, £5,000 single track mile is given for construction by the borough engineer, and this is taken by both, though it is thought that 25 per cent. could be taken off in so far as the laying down of the electrical system is concerned. Dr. Hopkinson allows 10 per cent. on outlay for depreciation, a total of £37,745, against Mr. Colam's £10,602. The electrical method of propulsion is declared to be extremely flexible; the cable car must go forward, it has to be uncoupled and pushed back. Special arrangements are suggested for working the steep gradients by electric power, nothing of the kind is required with the cable, and the reporter on the latter sees no difficulty in crossing the bridge with cable haulage. Such are a few comparisons in the report." The Special Committee, of which Alderman Newton is chairman, called for a special meeting on Tuesday.

On Tuesday last (23rd) a specially convened private meeting of the New Tramways Committee of the Newcastle-on-Tyne Town Council was held for the purpose of discussing the reports forwarded by Dr. J. Hopkinson and Mr. W. N. Colam with reference to the probable adoption of either the electric or cable systems. No definite expression of opinion, we are informed, was arrived at, though it was eventually decided to form a sub-committee, who will submit the result of their deliberations to the General Committee some time next week.

**Rhyl.**—The District Council has referred to a committee a letter received from Messrs. A. Dickenson & Co., Birmingham, asking whether the Council would now favourably consider a proposal to lay down an overhead wire electric tramway between Prestatyn and Rhyl, starting from near the Grand Pavilion.

**Shanghai.**—The Special Commission of the Municipal Council has gone into the question of electric tramways, and has approved of the adoption of the overhead trolley system. There will be three routes. It has been decided to give a concession for the construction of the line and all accessories to a syndicate or company to be known as the "Shanghai Tramway Company." The concession is to be for 30, 40, or 50 years, according to the tender that the ratepayers may decide to accept, and the company to pay the Council a percentage of the total gross receipts for the period of the concession. Notification to tenderers by public advertisement will follow in due course, and the tender finally selected will be submitted to the ratepayers for ratification.

**Spain.**—The central power station in connection with the electric tramways in Madrid is approaching completion. The plant comprises two Babcock & Wilcox boilers, two 500-H.P. horizontal engines, by Messrs. E. P. Allis & Co., of Milwaukee, Wis., one Canadian built 110 H.P. ditto., two General Electric eight-pole dynamos, giving 750 amperes at 550 volts, and one ditto., giving 140 amperes at 550 volts.

**Tynemouth.**—At last week's meeting of the Town Council Mr. J. P. Spencer moved a resolution asking the Council to consider the advisability of laying new tramways from the New Quay at North Shields to the borough boundary at Cullercoats. He pointed out that the Corporation had been negotiating with the British Electric Traction Company for 12 months, and they were no further forward. They could not come to terms regarding the supply of electric motive power by the Corporation to the company, and that appeared to him to be the real point at issue. His motion did not pledge the Council to spend any money, nor to any specific policy.—Alderman Elliot seconded, and remarked that the Traction Company were behaving in a very unbusinesslike manner. The motion was carried unanimously.

## TELEGRAPH AND TELEPHONE NOTES.

### Telegraphic Interruptions and Repairs:—

| Cables. | Down. | Repaired. |
|---|---|---|
| **West Indies—** | | |
| St. Croix-Trinidad ... | Nov. 30th, 1896 ... | ... |
| **Amazon Company's cable—** | | |
| Cable beyond Gurupa ... | June 8th, 1898 ... | ... |
| Accra-Kotonou ... ... | Aug. 8th, 1898 ... | ... |
| Hong Kong-Manila ... ... | May 3rd, 1898 ... | August 22nd, 1898 |
| Cyprus-Latakia ... ... | Feb. 10th, 1898 ... | ... |
| Bolama-Bissao ... ... | July 21st, 1898 ... | ... |
| **Landlines.** | | |
| Saigon-Bangkok ... ... | August 20th, 1898 ... | August 20th, 1898 |
| Saigon-Bangkok ... ... | August 22nd, 1898 ... | August 23rd, 1898 |

**Cable from Brest to Cape Cod.**—Mr. W. W. Howell, representative in England of the Compagnie Française des Cables Télégraphiques, writes to the *Times* from 24, Royal Exchange, E.C.:—"Referring to the announcement in your issue of August 18th respecting the Brest-Cape Cod Cable (which we have just completed), will you kindly permit me to point out that this cable has not been laid for a telephone company, but for the Compagnie Française des Cables Télégraphiques?"

**Cape Town.**—By the last mail we learn that the underground telephone system in Cape Town was on the eve of its practical completion, and that the Postmaster-General was about to open a telephone call office at the telegraph counter of the new General Post Office. In each corner of this call office, which is handsomely fitted up, is fixed a silence cabinet, into which exchange subscribers and the general public will be admitted for the purpose of communicating with subscribers to the Cape Town telephone exchange, and with subscribers to the suburban exchanges which are to be established at any early date. It is the intention of the Post Office department to open call offices at convenient points throughout the city and suburbs, so that telephonic communication with business firms in town may be brought within easy reach of the general public.

**Glasgow Telephones.**—The Corporation Telephone Committee have resolved to renew their application for a telephone license, and a deputation has been appointed to interview the Duke of Norfolk and Mr. Hanbury as soon as a meeting with those officials can be arranged.

**Huddersfield Telephones.**—The Council has decided to take steps to acquire a local telephone service, and the Town Clerk is to take steps to secure the necessary Parliamentary powers, unless the Government in the next session of Parliament introduces and passes into law a Bill authorising the Post Office authorities to grant licenses to local authorities for the installation of a telephone service, containing borrowing powers and other powers similar to those afforded by the Electric Lighting Acts.

**Tunbridge Wells Telephones.**—The Tunbridge Wells Farmers Club held a discussion upon the unsatisfactory state of the telephones in the district on Friday night, and it was unanimously resolved: "That in view of the recommendations of the Select Committee on Telephones local authorities should be empowered to supply telephone service in their localities; the Tunbridge Wells, Tonbridge, and District Farmers Club desire to express their opinion that the time has now arrived when it is desirable that the Corporation of Tunbridge Wells should apply forthwith to Her Majesty's Postmaster-General for a municipal telephone license for this town and district."

**The Telephone Report.**—Within the past week several letters have been appearing in the *Times* from the pen of Major-General C. E. Webber, commenting upon the report and recommendations of the Select Parliamentary Telephone Committee.

**The Iceland Cable.**—A daily paper says that the long-projected scheme for the laying of a telegraph cable to Iceland, in which the Great Northern Telegraph Company, of Copenhagen, is largely associated, is now about to be carried into practical effect. The cost is estimated at 450,000 kroner, of which the Telegraph Company will contribute 300,000, whilst the remainder will be provided by the Iceland Althing. The cable will be laid *vid* Scotland to the east coast islands in such a manner that it will be possible to place all the important parts of the island in telegraphic communication with the whole world.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Ashton-under-Lyne.**—August 27th. The Committee of the Central Conservative Club invite specifications and tenders for the installation of the electric light in the club buildings. Tenderers will have to prepare a complete specification. Tenders to Mr. John Moss, secretary.

**Ashton-under-Lyne.**—August 29th. The Electricity Committee want offers from persons desirous of entering into arrangements for the wiring of premises within the borough on any system of deferred payment. Particulars from Messrs. Lacey, Clirehugh and Sillar. See our "Official Notices" August 5th for particulars.

**Austria.**—September 15th. Tenders are being invited by the Austrian State Mining Authorities for the supply of 13,000 pairs of arc lamp carbons required for the State silver and lead mines. Tenders, marked "Offert auf Material Lieferung," to be sent to Die K. K. Berg, direction, Pribram, Austria, from whence particulars may be obtained.

**Bangor.**—September 10th. The Corporation is inviting tenders for the supply and erection of two water-tube boilers, economisers, steam and other pipes, pumps, &c., two 60-kw. dynamos, balancer, boosters, 5-ton travelling crane, switchboard, accumulators, mains, &c. Consulting engineer, Mr. F. H. Medhurst. See our "Official Notices" August 12th, for particulars.

**Belgium.**—October 27th. The municipal authorities of Ghent are inviting tenders until October 27th for an installation of electric lighting in the new Flemish theatre in that town. Tenders to L'Hotel de Ville, Ghent, Belgium, from whence particulars may be obtained.

**Buxton.**—September 5th. The District Council wants tenders for the supply of water-tube boilers, mechanical stokers, engines, dynamos, pumps, &c., battery, switchboard, exhaust, feed, and other pipes for the establishment of electricity works. Consulting engineer, Prof. A. B. W. Kennedy. See our "Official Notices" August 12th.

**Kennington.**—September 2nd. The Robert Arthur Theatre Company is inviting tenders for the supply and erection of plant for the electric lighting of the Princess's Theatre, Kennington. Consulting engineers, Messrs. Owen, Lucas & Pyke, 39, Victoria Street, S.W. See our "Official Notices" this week for particulars.

**Kingston-upon-Hull.**—September 30th. The Corporation want tenders for the supply of 45 electric motor cars, 20 trailers, 2 sprinkler cars, and 2 traversing platforms. Specifications from Mr. White, city engineer. See our "Official Notices" August 19th.

**King's Lynn.**—September 7th. The Corporation is inviting tenders for various works in connection with the electric lighting of the borough, including gas-producing plant, gas engines, dynamos, switchboard, motor transformer, electrical instruments, fittings, &c., batteries, armoured cables, and other mains, pipes, stoneware culverts, fuse boxes, &c. Consulting engineer, Prof. Henry Robinson, C.E., 13, Victoria Street, Westminster, from whom particulars may be obtained on payment of 2s. for each contract.

**Kingston-upon-Thames.**—September 5th. The Committee of the Kingston Victoria Hospital is inviting tenders for the wiring and fitting for electric lighting of the Kingston Victoria Hospital, Coombe Lane, Kingston-upon-Thames. Particulars at the office of the Hon. Consulting Engineer, Central Electric Station, Down Hall Road, Kingston-upon-Thames.

**North Staffordshire.**—September 5th. The British Electric Traction Company is inviting tenders for the provision of materials and construction of the track and permanent way of about 13 miles of tramways (in sections) in the Potteries district of North Staffordshire, for the British Electric Traction Company, Limited. Particulars obtained on payment of a deposit of £3 3s. at the Company's Permanent-way Engineer's Office, Donington House, Norfolk Street, Strand, W.C.

**Patras.**—The following notice appears in the *Times*:—"On Sunday, the 16-28 August of this year, in the morning, from 9-11 o'clock, will be given out in submission, in the Town Hall of Patras, in presence of the Municipal Council, and in public session, the concession of the lighting of Patras and its suburbs. In case the lighting will be executed by gas, the period of the concession will be of 35 years, or in case the lighting will be executed by electric light or another light, the duration of the concession will be left to the discretion of the competitor, according to the conditions of our advice No. 2,222 of this year and according to the register of February 7th, 1898, modified by the above-mentioned advice No. 2,222. Offers are to be submitted under sealed cover. A copy of the above-named documents, in Greek or in French, will be delivered to every interested firm which will ask it from us or from the president of the municipality.

"Patras, July 12th, 1898.

"The Mayor of Patras,
"Thanos Canacaris."

**Rochdale.**—September 6th. The Corporation wants tenders for the supply of boilers, economisers, condensing plant, feed pumps, steam and exhaust piping, travelling crane, switchboard, accumulators, and cables for the electricity installation which is to be put down. Consulting engineers, Messrs. Lacey, Clirehugh and Sillar. See "Official Notices" August 5th for particulars of the various sections.

**Roumania.**—September 22nd. Tenders are being invited until September 22nd by the municipal authorities of Braila, Roumania, for the concession for the electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, La Mairie de Draila, Roumania.

**Southport.**—Tenders are being invited for the construction of an electric railway from Southport to Lytham. For particulars write (with £2 2s. deposit) to Mr. Stewart Speddy, 7, Post Office Avenue, or 118, Hampton Road, Southport.

**Wimbledon.**—August 29th. The District Council invites tenders for the supply, delivery, and erection of pipe work. Mr. A. H. Preece, consulting engineer. See our "Official Notices" August 5th.

### CLOSED.

**Bournemouth.**—The following is a list of the tenders submitted for the installations at the pier, pleasure grounds, and winter gardens, together with switchboards, cables, arc lamps, incandescent lamps, wiring, fittings, &c. (contract No. 1), Mr. F. W. Lacey, M.Inst.C.E., borough engineer and surveyor:—

| Name. | Pier. | Pleasure Grounds. | Winter Gardens. | Switchboard, &c. | Total. |
|---|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| Leonard G. Tate .. | 947 0 0 | 712 0 0 | 1,090 0 0 | 248 0 0 | 2,997 0 0 |
| The Walsall Electrical Company, Limited .. | 978 0 0 | 639 11 6 | 684 6 6 | 443 18 6 | 2,695 16 6 |
| Siemens Bros. & Co., Ltd. .. .. .. | .. .. | .. .. | .. .. | .. .. | 2,192 0 0 |
| Crompton & Co., Ltd. .. | 743 0 0 | 574 0 0 | 610 0 0 | 170 0 0 | 2,097 0 0 |
| Johnson & Phillips .. | 771 18 0 | 479 6 6 | 572 0 0 | 259 17 0 | 2,083 1 6 |
| R. Alger & Sons .. .. | 514 14 5 | 490 3 2 | 669 16 0 | 192 15 4 | 1,867 8 11 |
| Cash, Robinson & Co... | 474 13 3 | 369 6 2 | 620 0 11 | 320 1 0 | 1,784 1 4 |
| *The Brush Electrical Engineering Co., Ltd. | 438 0 0 | 375 0 0 | 578 0 0 | 207 0 0 | 1,598 0 0 |
| Warburg, Dymond & Co. (Informal) | | | | | |

* Accepted.

**Contract No. 2.—Electric lighting of pier, pleasure grounds, and winter gardens. The following tenders were submitted for the supply of steam dynamo, &c.**

| Name. | Type of engine. | Price. |
|---|---|---|
| | | £ s. d. |
| Leonard G. Tate .. .. | Scott & Mountain .. .. | 1,565 0 0 |
| Brush Electrical Engineering Company, Limited .. | Universal (Brush Company) | 1,367 10 0 |
| R. Alger & Sons.. .. .. | Ransomes, Sims & Jefferies (compound) .. .. .. | 1,425 0 0 |
| | Ransomes, Sims & Jefferies (double cylinder) .. .. | 1,337 0 0 |
| United Ordnance and Engineering Co., Ltd. .. .. | Willans & Robinson .. .. | 1,125 0 0 |
| | Own manufacture .. .. | 1,253 0 0 |
| J. H. Holmes & Co. .. .. | Belliss & Co. .. .. .. | 1,270 0 0 |
| | Belliss & Co. .. .. .. | 1,420 0 0 |
| | Willans & Robinson .. .. | 1,090 0 0 |
| Electric Construction Company, Limited .. .. | Belliss & Co. .. .. .. | 1,261 0 0 |
| | Belliss & Co. .. .. .. | 1,458 0 0 |
| | Willans & Robinson .. .. | 1,209 0 0 |
| Crompton & Co., Limited .. | Belliss & Co. .. .. .. | 1,319 0 0 |
| | Belliss & Co. .. .. .. | 1,376 0 0 |
| | Willans & Robinson .. .. | 1,075 0 0 |
| Johnson & Phillips .. .. | Belliss & Co. .. .. .. | 1,150 0 0 |
| | Belliss & Co. .. .. .. | 1,325 0 0 |
| | Willans & Robinson (simple) | 1,080 0 0 |
| | Mirrlees & Watson (compound) | 1,215 0 0 |
| *Siemens Bros. & Co., Limited | Belliss & Co. .. .. .. | 1,135 0 0 |
| | Willans & Robinson .. .. | 1,085 0 0 |
| Cash, Robinson & Co. (Informal). | | |
| Mather & Platt ,, | | |
| Warburg, Dymond & Co. ,, | | |

* Accepted.

**The tenders received for the supply of electric light pillars, as follows, viz.:—(*a*) 9 cast-iron ornamental lamp pillars, (*b*) 10 cast-iron ornamental lamp pillars, with special flanges, (*c*) 19 ornamental carriers for arc lamps, were as follows:—**

| | (*a*) each. | (*b*) each. | (*c*) each. |
|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. |
| J. Allen, sen., & Son .. .. .. | 18 5 0 | 18 5 0 | 7 0 0 |
| Geo. Smith & Co. .. .. .. .. | 12 5 0 | 12 5 0 | 5 10 0 |
| *W. Macfarlane & Co. .. .. .. | 10 4 0 | 12 18 0 | 7 16 0 |

* Accepted.

## NOTES.

**Submarine Telegraphs.**—With reference to Mr. C. Bright's letter on page 301 of this issue, no doubt our reviewer will deal with this in our next issue, and in a manner which, if not entirely to the satisfaction of Mr. Bright, will more than justify his really mild criticisms of the work in question.

**Current Density as a Factor in Copper Refining.**—The recollection of the mystery which surrounded the electrolytic copper refining industry, as it existed 15 or 20 years ago, may now well raise a smile among those who in these days handle thousands of tons of copper matte monthly. The secret of success was supposed to rest safely with a few German establishments, and with one well-known gold and silver refining concern in this country. Of course, says the New York *Electrical Engineer*, there was no secret in the real sense of the word; but, nevertheless, besides this supposed barrier, there were substantial deterrents to the undertaking of electrolytic refining work, and principal among these was the great cost of the plant, and particularly the long period of time during which a large stock of metal remains unproductive of interest while undergoing the process. It is perhaps to the great reduction in the latter item that the notable increase in electrolytic metal refining work is attributable. This is well brought out in a very able review of the situation by Mr. Titus Ulke appearing in the *Engineering and Mining Journal*. It was not at all uncommon 10 years ago for copper refiners to stock their tanks with 75 to 100 times as much copper as was daily produced in regular work. This enormous disparity has been gradually reduced, so that to-day only from one-fourth to one-fifth that amount is required, or an average of 15 to 20 tons per ton of output. For the ultimate cause of this marked improvement we must look to the method of handling the baths, and especially to the higher current densities now made practicable. Whereas formerly currents of only 2 to 4 amperes per square foot were thought permissible, to-day current densities of from 15 to 20 amperes are employed in some establishments, and the end is not yet in sight. The conclusion reached by Mr. Ulke is that the average proportion between the total copper "in process of treatment," and the yearly capacity (measured by output) of our electrolytic copper works is now about 4 per cent., as against two or three times as much formerly, and that the average proportion is going to decline still lower within the next year or two. These are interesting developments, and it is safe to say that with the water-powers now being rapidly developed in the United States, we shall see still further increases in the electrical metal refining industries.

**Gas Failure.**—Whenever there is the slightest failure in the electricity supply of any district, our newspapers make an alarming fuss, often far greater than is warranted when the facts are known. Of course, electricity is blamed, and the writers, and in the majority of cases, the readers also, overlook the fact that gas lighting is responsible for many very serious explosions and failures in the course of 12 months. On Monday evening this week, Tonbridge was plunged into darkness at eight o'clock at night, when the business of the town was in full swing. For about six minutes the business portion of the town was in absolute darkness, and much inconvenience was caused at the station in connection with the working of the signals. It is stated that the sudden defection of the gas was due either to an accident to a pipe in the gas-holder or to negligence in allowing a water syphon to become filled, thus shutting off the supply. The manager of the gasworks caused a fresh holder to be turned on, and in a short time the town was again in its normal condition.

**Institution of Mining Engineers.**—The ninth annual meeting of this Institution is to be held at Birmingham on Tuesday, September 13th. Among the papers down for reading is one on "The South Staffordshire Mines Drainage Scheme, with Special Regard to Electric Power Pumping," by Messrs. E. B. Marten, M.I.E.E., and Mr. E. Howl.

**The Early Days of Electricity.**—Prof. Elisha Gray had some interesting revelations to make the other day at a meeting of the North-Western Electrical Association at Puluth respecting the difficulties under which the pioneers of electricity worked in those early days when, as he said, "practical electricians knew nothing about the relations of wires to magnetism, resistances, &c." The first man who came to America with a Varley rheostat was a great man, and he used to carry it about under his arm, whilst people wondered. Prof. Gray amused his audience by referring to the lectures of a certain professor of physics before the invention of the telegraph. He was taking his class through a course of "electricity," showing the experiments with the frictional machine, and telling the students "how Franklin caught the forked lightning from the clouds, tamed it, and made it subservient to the will of man." He seems to have waxed enthusiastic, and to have wound up his lecture with a regular 4th of July speech, saying finally: "Young men, you were born too late to witness the development of this great science—electricity." We wonder what the old professor thinks now, if it is possible for him to look down upon the progress that electricity has been making since his time, and whether he remembers that little speech he made to the boys over 50 years ago on the subject of electricity. *Tempora mutantur et nos mutamur in illis.* Prof. Gray, it seems, has a reputation for wit, and he seems to have excelled himself on this occasion. We do not know whether the verses which he quoted towards the close of his remarks are his own composition, but they are new to us. The subject is the difference between the "now and the then," and they run as follows:—

"In the olden time, along the street,
A glimmering lantern led the feet
When on a midnight stroll;
But now we catch, when night is night,
A piece of lightning from the sky
And stick it on a pole.

"Time was when one must hold his ear
Close to the whispering voice to hear,
Like deaf men, nigh and nigher;
But now, from town to town he talks,
And puts his nose into a box
And whispers through a wire.

"In other days we took a car,
Drawn by a horse, if going far,
And felt that we were blest;
But now the conductor takes the fare,
And sticks a broomstick in the air—
And the lightning does the rest."

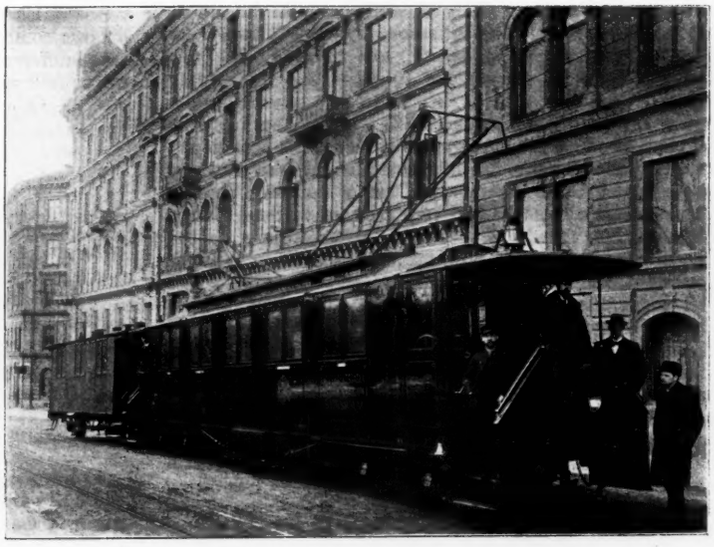
**Condensing Water Coolers.**—We have received from the Klein Engineering Company, of Manchester, a circular urging the use of apparatus for cooling water over and over again for condensing purposes. The arrangement of the cooler is not sufficiently indicated by the description of it, or by its pictorial representation, but we take it to be of the kind which exposes thin films of water over a large area to the evaporative effect of the atmosphere. It is claimed that an ordinary open self-ventilating cooler will occupy about 1 square foot of floor space per I.H.P., and a height of 16 to 20 feet. With fan ventilation, about a sixth the area only is required, while one for self-ventilating chimney type requires about one-third the area of the first type. There can be no doubt that did steam users more fully realise the possibilities of water coolers, the use of condensing plant would considerably extend.

**A Big Prize for an Automobile Accumulator.**—At a recent meeting of the committee of the French Automobile Club a letter which had been received from a firm of accumulator manufacturers was read. In this letter, says an American Exchange, the firm, whose name was not made public, offered to set aside a sum of $5,000, to be given to the maker of any accumulator which could be proved to be better than their own. The committee resolved to write to the firm in question, stating that they were willing to accept the $5,000, and to make it a prize for the best accumulator in the secondary-battery competition, which it is proposed to hold next winter.

**The Late Dr. Cornelius Herz.**—Letters of administration to his estate have been granted to the widow of the late Dr. Cornelius Herz, the whole of the deceased's estate being sworn at £20.

**A Dream.**—Prof. Arthur Schuster is much to be envied. He is able to dream through his holidays, and sternly to refrain at other times. Even the approach of a British Association meeting concentrates his faculties. His dreams are most fanciful, yet most coherent, most romantic and yet most practical. His mind retains them for his waking hours, and his pen describes them in *Nature* with every charm of literary style. He is nearly convinced of their truth, and this surely is the note of a perfect dreamer. How is it that other modes of attraction require agents of two opposite kinds, and are accompanied by repulsion, while gravitation requires but one kind, and knows no repulsion? Why do magnetic and electrical actions seem essentially to require that the molecule should be arranged about an axis, with opposite properties in its two senses, while gravitation asks for nothing of the sort? The answer is obvious. Matter has its mate. There are two kinds of matter mutually repellant, and our world consists entirely of the one kind, and has none of the other. It has been repelled into space. As his maid knocks at the door with the hot water, the professor wonders, can this be true? Of course it is true. Anti-matter is what Alice found behind the looking glass.

**The Wenstrom Machines.**—The Fuller-Wenstrom Electrical Manufacturing Company have recently started business in this country as manufacturers of the well-known Wenstrom machines. We have just had an opportunity of inspecting some of the machines at the company's office, and we were most favourably impressed with the excellence of the manufacture. Single-phase alternating motors form a special feature of the company's work, and judging from the ease with which single-phase motors were started on full load, there ought to be considerable business in this direction. The company are making a speciality of three-phase plants, and in this particular branch they have the great experience of their Swedish engineers. The illustration shows a continuous current tramway recently put down in Stockholm by the Wenstrom Company, and which is giving great satisfaction. The company inform us that they have already large orders on their books, and we wish them every success in their new enterprise.



**The Rumour about Mr. Preece.**—Statements have appeared in various London and provincial papers to the effect that the Postmaster-General has requested Mr. W. H. Preece, C.B., the electrician-in-chief to the Post Office, to continue in that position for several years longer, notwithstanding the fact that he was to retire this year. It has been stated that such an arrangement pointed to immediate steps being taken by the Post Office for the establishment of a complete State telephone system. We are authorised to say that there is no foundation for this report, which must be looked upon as a quite unauthorised newspaper *canard*.

**The Present Status of Electrical Engineering.**—In reviewing the progress of electrical work, Dr. A. E. Kennelley stated recently that in 1884, outside telegraph and similar work, he doubted if the capital invested in electrical work in the United States exceeded a million dollars. To-day it is estimated at 1,900 millions, or nearly £400,000,000 sterling. At the former date a 50 kw. machine was large, while a 100 kw. was called a "Jumbo," from its supposed elephantine proportions. To-day the largest machines building, or built, are of 4,600 kw. capacity. In 1882 prices of dynamos were about 10d. per watt of output. Now they cost about 1d. per watt. Yet efficiencies are but little improved, except in respect of output per unit of mass. In 1882 a 92 per cent. efficiency accompanied an output of 13·2 watts per kilo. of weight. Now about 22 watts per kilo. are obtained. The cost of a kw.-hour in 1884 was 7½ cents. To-day it is but 1 cent, and even half this has been reported. Lamps of 16 C.P., which cost $1, now cost 18 cents. The best gave 0·28 C.P. per watt, against 0·4 to-day. The best secondary cells in 1884 gave 3·425 watt-hours per pound of electrode, at an efficiency of 69·45 per cent., at a mean rate of 12·42 amperes per square foot of negative. Now they yield 5 to 6 watt-hours per pound of charged cell at 85 per cent. efficiency at 4·8 amperes of foot of negative plate. The largest battery in America has 166 cells, weighs one million pounds, and has an eight-hour discharge of 22,400 ampere-hours. In traction the introduction of soft cast steel has raised motor output from 5 to 14 watts per pound, and assisted to extend the system of lines to the present 14,000 miles, employing 170,000 men; while in power transmission the North American continent has 150,000 kilowatts of power transmission machinery up to 85 miles, and as high as 30,000 volts. In hot weather the fan motor load of large cities is already a perceptible item. The difference between high and low tension, and frictional electricity is rapidly disappearing as a study, one theory going to serve the whole. Up transformed current has invaded the field of frictional electricity, as seems only what might have been foretold. Alternating currents, power transmission, the domestic applications of electricity, the telephone, all stand far in advance of their position, but a few years ago while in the still subtler forms, radiography and all that it implies stand as evidence of electrical progress. The author finally points to the importance of reasonable standardisation. While it may be true that a too rigid adherence to standard forms may tend to hinder progress or improvement, it is a fact that the industrial application of electricity will be furthered by reduced costs of production such as standardising alone can effect. Thus the extensive sale of a given standard for a short time will really put a manufacturer in a better position to make an advance to a fresh standard than a meagre sale. The security of standardising lies in the fact that there is a certainty for a few years during which orders can be taken at minimum prices and in larger numbers than when invention is too rife. Too many so-called improvements are mere alterations for the sake of alteration. A tendency to standardise would check this, while still allowing genuine improvements to assert themselves.

**The "Riker" Electric Phaeton.**—During this week Messrs. Shippey Bros., Limited, the sole selling agents for this country, are exhibiting at the Agricultural Hall, Islington, the Riker electrical phaeton, which is of the latest American design, manufactured under the patents of the Riker system of Brooklyn, U.S.A. There was a private inspection of the motor carriage at Northumberland Avenue last week. It is stated that a company is to be shortly floated for building these vehicles in this country.

**Ionic Reactions and their Significance in Electro-Chemistry.**—In a lecture given a short time ago by Friedrich W. Küster, in which the bearing of the ionic hypothesis on chemistry was dealt with, the following lecture experiments were described:—In order to show the electrical exchange represented by the equation $Cu^{++} + Fe = Cu + Fe^{++}$, pieces of iron and copper are immersed in a solution of sodium sulphate, the former near the top, the latter near the bottom of the vessel. A few crystals of copper sulphate being brought into the liquid near the copper, a current at once flows from the copper to the iron through the external circuit. The change, $2\,Fe^{+++} + Fe = 3\,Fe^{++}$, is similarly illustrated by using two iron plates in a solution of common salt, and placing some ferric chloride near the lower one. The electrical exchanges connected with the reversible reaction, $Fe^{++} + I = Fe^{+++} + I^-$, are shown by means of two platinum electrodes standing in small crystallising dishes, which are placed in a larger dish. The latter is filled with a solution of potassium chloride, and under it some iodine is placed in the one small dish, and a strong solution of ferrous chloride in the other. The current then flows (in the external circuit) from the iodine to the ferrous solution, but by increasing the concentration of the iodine ions or of the ferric ions, the reaction, and with it the direction of the current, is reversed. The change, $I^- + Br = Br + I$ is demonstrated in a similar manner. If electrodes of iron and platinum respectively are immersed in a solution of potassium chloride, and a little iodine added in the vicinity of the platinum, a current is developed owing to the reaction, $Fe + 2\,I = Fe^{++} + 2\,I^-$. A saturated solution of hydrogen chloride in toluene does not conduct electricity, even under a pressure of 72 volts, nor does it act on calcium carbonate, but the addition of a little water enables it to do both the one and the other. A saturated (about 0·1 normal) solution of carbonic acid colours methyl-orange less intensely red than a 0·01 normal solution of acetic acid, owing to the difference in their dissociation. The diminution of dissociation produced by increasing the concentration of one ion is shown by adding a trace of sodium hydrogen carbonate to the carbonic acid, whereon the red colour disappears, or of sodium acetate to the acetic acid solution. No change of colour is produced by adding sodium chloride to a weak solution of hydrochloric acid coloured by methyl-orange. Another phenomenon of a similar kind is the precipitation of lead chloride from its saturated solution by the addition of a solution of common salt. The presence of copper in the form of a cathion in a solution of copper sulphate, and in the form of a complex anion in Fehling's solution, is proved by passing a current through two U-tubes, one of which contains a solution of cupric sulphate, on the surface of which a solution of sodium sulphate floats, whilst the other is similarly filled with Fehling's solution, and an alkaline solution of Rochelle salt. The blue ozone in the one tube moves in the same direction as, in the other tube in the opposite direction to, the current. The absence of cupric ions from Fehling's solution is further shown by means of a galvanic cell containing lead and copper immersed respectively in solution of lead acetate and copper sulphate; in this combination lead dissolves, and copper is precipitated, but both the reaction and the direction of the current are reversed when an alkaline solution of Rochelle salt is added to the cupric sulphate solution. For further particulars, consult *Zeitschrift für Elektrochemie*, iv., 105—113.

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**Water-Tube Boilers at Sea.**—Writing to *Engineering*, the Babcock & Wilcox Company send some figures for the purpose of showing how suitable their boiler is for marine purposes. Unfortunately, however, many essential figures are missing. It is satisfactory to find that the temperature of the funnel is not less than that of the boiler itself. Unfortunately, too many of the self-constituted advocates of water-tube boilers do the boiler the doubtful honour of crediting it with impossibilities. In the letter before us this is not so. A chimney temperature of 500° to 640° is somewhat reasonable, and is what ought to be obtained where the rate of fuel consumption is only the moderate one of 16 lbs. per square foot of grate. But we do not see of what possible utility it can be to state that a vessel at 8½ knots' speed only burned 6½ tons of coal per day. We are informed that at 12 knots the horse-power is 1,000. Therefore at 8½ knots the power will be, say, 360 H.P., for which power the coal consumed is quite sufficient, indeed, more than is regularly effected with other boilers. Of course 6½ tons looks small to the casual reader, who has been accustomed to hear about the hundreds of tons daily consumed by *Majestics* and *Lucanias*. The casual reader is also apt to think that a boat which will steam 12 knots at 1,000 H.P. will require 850 H.P. to steam 8½ knots, and for 850 H.P. the 6½ tons seems small. If figures are to be advanced on trials they should be plain. Instead, all the letter-press is descriptive of a gunboat for which no real comparison can be made, and the tabulated figures refer to two other ships. We should like to have heard something about the behaviour of the boilers with the Yorkshire bituminous coal. Did it smoke? Was there any special alteration of furnace made to prevent smoke? Engineers are by no means yet satisfied that the water-tube boiler has proved itself so superior for marine purposes. The question of circulation is quite an open one. It is far from proved that circulation really takes place in water tubes. There are reasons to fear that—at least when forced with a hot fire—the tubes are often empty of water, and that they are exposed to severe water hammer effects. The Belleville boiler is too obviously bad in design for any one to doubt that it cannot be satisfactory on a rolling ship. The more inclined tubes of the Babcock boiler are less liable to damage it is true. We should like some information as to the behaviour over some months of the brickwork seats and walls. Brickwork in large masses is awkward material in a steamship. Are suitably protected metal cases yet used, and, if used, found satisfactory?

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**Fly-wheel Accident.**—Some months ago we recorded a curious fly-wheel accident which occurred at Messrs. Nalder Bros. & Thompson's works, and on Tuesday last the same firm experienced a similar accident. Fortunately, as on the previous occasion, the incident was unattended by personal injuries. It is surmised that the accident arose from a premature explosion in the gas engine cylinder, which set up a reversal of stresses on the fly-wheel. The spokes of the wheel were broken close to the rim, the rim itself being quite uninjured. The accident caused some interruption to the work, but repairs were speedily effected.

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**The New French Atlantic Cable.**—The completion of the New French Atlantic cable by the s.s. *Francois Arago* draws attention to the latest and apparently most extravagant piece of work in cable laying yet accomplished. We have seen a piece of the core, and compared its dimensions with the published figures, with which it closely agrees. It consists of a central copper wire of ·121 inch diameter surrounded by 12 wires of ·042 inch diameter. The whole is insulated with gutta-percha to a diameter of ·480 inch. Assuming the lay of the smaller copper wires to be 3 inches, this would give a conductor of 658 lbs. The sectional area of the gutta-percha is then ·151 inch, and the weight 398 lbs. The published figures are 661 lbs. and 400 lbs. These dimensions are very similar to those of the last Anglo-American cable, which had weights of 650 lbs. of copper and 400 lbs. of gutta-percha. The speed of the French cable for the same length should exceed that of the Anglo-American by 1 per cent., but differences in the quality of the insulation may well amount to much more than this, and we may make a fair comparison of the two cables by their lengths only. The length of the Anglo-American cable was 1,847 miles; that of the French is said to be 3,200 miles. These lengths make the speeds of the two bear almost exactly the ratio of 3 to 1 in favour of the English cable, and the percentage earning powers of the two 5 to 1, assuming them to have been laid equally cheaply. It is unlikely that the new cable was manufactured and laid under French superintendence as economically as the English one, considering the great experience our engineers have had; and the figures are a suggestive instance of the extravagance of French foreign policy. Our figures of the Anglo-American cable, laid in 1894, are taken from Mr. Dearlove's paper, published in a contemporary at that time. The errors in the figures given in this connection last week by the same journal apparently escaped their reader's notice.

**Death of one of Mr. Marconi's Assistants.**—We announce with sincere regret that Mr. Edward Edwin Glanville, of Trinity College, an assistant to Mr. Marconi, met with a fearful death on Tuesday at Rathlin Island, off Antrim coast, by falling over a cliff 300 feet high. Mr. Marconi and another assistant were at the time at Ballycastle, on the mainland, conducting experiments in wireless telegraphy with the deceased on the island, which is some miles off the coast.

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**Electrolytic Iron.**—In the spring of 1897, F. Haber had opportunities for inspecting the electrotype methods used by the Government printers of bank notes in Germany and Austria. The results of his work are given in the *Zeitschrift für Elektrochemie*, IV, 410. Both in Russia and in the latter country the notes are printed from steel-faced electrotypes, made by electrolytic deposition of iron from a bath prepared according to Klein's formula (ferrous and magnesium sulphates), under conditions of temperature and current density which have not been divulged. The latter is certainly very small, as a plate only 2 mm. in thickness requires 1½ months for deposition. The plates prepared in this way have the appearance of steel-faced copper plates; the under side is slightly rough, but the author did not observe any of the oval pittings spoken of by Lenz in his earlier paper on this subject. The thin iron electrotypes prepared as above are backed by copper in the usual manner. Their advantage lies in the fineness and hardness of the metal which is first deposited, and in the delicacy of the copy of the original which is thus obtained. The other plan of preparing these plates, first to obtain a copper electrotype of the original, and then to face this with iron by suspension as cathode in the above bath of ferrous and magnesium sulphates. The printing results are, however, not nearly so good as when the former method is employed. These plates coated with iron can be used for a much larger number of impressions than those of copper alone. The author notes that the first deposit of electrolytic iron is harder than the succeding ones, and that the variations in hardness are measured by the proportion of hydrogen present in the deposit. The disadvantage of these copper-backed iron plates is that they can only be renewed by the repetition of the whole process, whereas the iron-faced copper electrotypes can have their faces renewed in a few minutes. F. Haber had an opportunity of examining the chemical constitution of one of the plates deposited according to the methods used by the Austrian bank-note printers. The plate was 3 mm. thick, and could be bent double without fracture. Left for three-quarters of a year in a damp laboratory atmosphere, it showed no apparent signs of rusting. The original paper contains details of the gravimetric method employed for determining the hydrogen contained in this iron. He obtained a mean percentage of 0·015 per cent., which worked out to a volume ratio of hydrogen to iron of 17·3, or to a volume ratio of 12·0 when corrected for the errors of analysis. Lenz obtained volume ratios of hydrogen to iron varying from 13·4 to 16·3 in his experiment upon electrolytic iron. F. Haber next undertook the investigation of the conditions necessary in order to obtain a maximum amount of hydrogen in the deposited iron. Using a current density of 2,140 amperes per square foot, he obtained a deposit containing from 0·085 per cent. to 0·110 per cent. of hydrogen. This equals a mean volume ratio (hydrogen to iron) of 112. Lenz obtained ratios between 105 and 129 for this type of iron deposit. The latter found, in addition to hydrogen, carbonic acid, carbonic oxide, and nitrogen gas present in electrolytic iron, but the author has not had an opportunity for verifying these results. The deposit obtained by continued use of the high current density just named was perfect in every respect, with the exception of its tendency to cause curvature of the cathode. The author overcame this by using a revolving cylinder as cathode, within a larger iron tube, which acted as anode. If the electrolytic iron be heated in a Bunsen flame, the hydrogen and other gases escape with small explosions, and the remaining metal is then found to have lost its hardness, but is still less soft and pliant than wrought-iron of a similar thickness. In conclusion, F. Haber states his opinion that iron containing hydrogen undergoes change in physical structure with time. He commenced experiments bearing upon this point, with intermittent currents, but these are not yet completed.

**Decomposition of Compounds by Electrical Oscillations.**—In some recent experiments by Alexander de Hemptinne, various organic compounds were exposed in the gaseous state, at low pressure, to the influence of electrical oscillations, and the decomposition products were examined. From methylic and ethylic alcohols, mixtures of carbonic oxide, carbonic anhydride, hydrogen, and methane of ethane are obtained, and as the quantity of oxides of carbon is diminished if the decomposition occurs in the presence of phosphorus, the author considers these compounds to be due to secondary actions, the primary reaction being represented by $CH.OH = CH_2O$; analogous decompositions occur in the cases of propylic, isopropylic, and allylic alcohols. With acetone and propaldehyde, however, the presence of phosphorus causes no diminution in the quantity of oxides of carbon; these are hence produced in the primary decomposition, which is in each case $CHO = CH_2CO$. Acetaldehyde undergoes an analogous decomposition, but acetic and propionic acids decomposes with the formation of oxygen and the unsaturated hydrocarbon. Methylic acetate and ethylic formate give the same decomposition products, and the chemical formula gives no indication, in the author's opinion, of where the strongest mechanical attraction occurs. A few liquids were also exposed to the oscillatory discharge, and glycerol, glycol, glyoxal, glyceric acid, and oxalic acid, were all found to be partially decomposed. Phenol and benzoic acid yielded oxides of carbon and hydrogen, and resinous compounds, the latter, together with hydrogen and acetylene, also being formed from benzene. The above is an abstract of a paper in the *Zeitschrift für Physikalische Chemie*, 1898, xxv., 284, by Alexander de Hemptinne.

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**Electric Lighting of Balmoral Castle.**—Mr. W. H. Massey writes from Osborne:—"My attention has just been called to the note in your issue of the 19th inst., and although it is useless to attempt to overtake a lie when once well started in a 'daily paper,' perhaps you will be good enough to let it be known among electricians that it is *not* because of any delay in the lighting arrangements (which I tested when at Balmoral on the 11th inst.) that Her Majesty's departure from the south has been deferred for a week."

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**Power Station Tests.**—As we go to press the following letter comes to hand from Mr. A. K. Taylor:—"May I be allowed to point out what appears to be an error in your issue of the 19th inst? At the end of an extract from the *Street Railway Journal* on 'Power Station Tests,' the coal consumption per electrical H.P.-hour is given as 2·4, and the coal per kilowatt-hour is also given as 2·4 lbs.; should not the latter have been 3·22 lbs.? This coal consumption is commented on in the last few lines of the extract."

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**Appointment Vacant.**—The Greenock Board of Police are inviting applications for the position of resident electrical engineer at £300 per annum. The duties include the devising of a scheme for electric lighting for Greenock and contiguous districts, and carrying same into effect. Applications to be sent to the Town Clerk by 31st inst. at 12 o'clock.

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## NEW COMPANIES REGISTERED.

**Berry's Electrical Company, Limited** (58,587).—This company was registered on August 17th, with a capital of £3,000 in £1 shares, to acquire and carry on the business of electrical and mechanical engineers, machine tool makers, iron and brass founders, consulting engineers, machinery agents, and mill furnishers now carried on by Richard Berry and Francis Wareing, at 7, St. Martin's Row, Broad Street, Birmingham, as "R. Berry & Co." The subscribers (with one share each) are:—John B. Chatterley, 117—119, Newtown Row, Birmingham, manufacturer; Francis Wareing, 18, Richmond Road, Olton, Warwick, clerk; Albert E. Chatterley, 117—119, Newtown Row, Birmingham, manager; Richard Berry, 7, St. Martin's Row, Birmingham, electrical engineer; Walter G. Floyd, 48, Cherry Street, Birmingham, accountant; Percy N. Chatterley, 7, St. Martin's Row, Birmingham, electrical engineer; Edward Rowlands, 41, Temple Row, Birmingham, solicitor. The

number of the directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, £25; remuneration as the company may determine.

**Siddall & Hilton, Limited** (58,588).—This company was registered on August 17th, with a capital of £100,000 in £10 shares (5,000 perference), to acquire the businesses carried on at Sowerby Bridge, Yorkshire, as "Rowland Siddall"; at Manchester, as "The Manchester Spring Mattress Company, Limited"; at London, Manchester, Dublin, Bristol, and Newcastle-on-Tyne, as "Rowcliffes & Hilton, Limited"; and at Sowerby Bridge, Yorkshire, as "The Yorkshire Bedstead Company, Limited," and to carry on the business of wire mattress and bedstead manufacturers, furniture dealers, ironmongers, tube makers, mechanical and electrical engineers, &c. The subscribers (with one share each) are:—Rowland Siddall, West Royd, Sowerby Bridge, Yorkshire, spring mattress manufacturer; Thomas Hilton, Ridgemount, Winchmore Hill, N., spring mattress manufacturer; Herbert Siddall, Bank Villas, Sowerby Bridge, Yorkshire, bedstead manufacturer; Arthur Siddall, The Mount, Sowerby Bridge, Yorkshire, worsted spinner; George Hilton, 30, Rothbury Terrace, Newcastle-on-Tyne, works manager; John Hilton, 25, St. Laurence Road, Clontarf, Dublin, works manager; Robert Hilton, 110, Platt Street, Moss Side, Manchester, sculptor; and George Maskew, 21, Wade Street, Halifax. The number of directors is not to be less than two nor more than seven; the first are Rowland Siddall and Thomas Hilton; qualification, 100 shares; remuneration as fixed by the company.

**Highland Water-Power Syndicate, Limited** (58,601).—This company was registered on August 18th, with a capital of £20,700 in £1 shares (700 deferred), to carry on the business of electricians, electrical engineers, and producers of electricity by water and other power, and to acquire, own and work any lands, water rights, &c. The subscribers (with one share each) are:—Philip G. Tovey, 28, Trothyb Road, Southwark Park Road, clerk: A. W. Hall, 77, Mexfield Road, Putney, S.W., secretary; Harry M. Atchley, 5, Wyndham Crescent, N., accountant; Valentine Goodman, Tregsthnan, Leyton, E., clerk; E. Dowdeswell, 33, Cranleigh Road, West Green, N., clerk; Robert C. Kirkman, The Limes, Stafford Road, Wallington, Surrey, clerk; and John T. Brice, 44, Roderick Road, Gospel Oak, clerk. The number of directors is not to be less than two nor more than eight; the first are Lord Tweedmouth, Lord Kelvin, C. C. Macrae, M. F. Armstrong, J. H. Lukach, and G. Anderson; qualification, 10 deferred shares; remuneration, £1,000 per annum, divided between them.

**Falcon Iron Works, Limited** (58,607).—This company was registered on August 19th, with a capital of £5,000 in £1 shares, to enter into an agreement with J. Wild & Co., Limited, and others, and to carry on the business of electricians, electrical and mechanical engineers, boiler-makers, iron and brass founders, steel converters, &c. The subscribers (with one share each) are:—Tom Rothwell, Belgrave Road, Oldham, machinist; James H. Fisher, 9, South Parade, Manchester, yarn agent: J. Wild, 548, Oldham Road, Failsworth, tailor; James Procter, Wallshaw Place, Oldham, draper; Edward W. Marsland, Wallshaw Place, Oldham, surgeon; J. S. Hulton, 16, Clegg Street, Oldham, accountant; James J. Mannock, 73, Greengate Street, Oldham, works manager. Registered without articles of association. Registered office, Falcon Street Oldham, Lancs.

**George Lock & Co., Limited** (58,612).—This company was registered on August 19th, with a capital of £10,000 in £10 shares, to take over the assets of a company of the same title, and to carry on the business of builders, decorators, furnishers, silk mercers, gas and electric light fitters, &c. The subscribers (with one share each) are:—W. Farrier, 16, High Street, Homerton, clerk; James M. Goddard, The Mount, Shiere, Surrey, gentleman; Harry F. Newman, 28, Elthiron Road, Poole Park, Fulham, S.W., printer; J. J. Hulse, 34, Hugon Road, Fulham, printer; W. H. Bennett, 172, Clarence Road, N.W., printer's reader; J. Sullivan, 21, Trott Street, Battersea, S.W., compositor; John Hulse, 34, Hugo Road, Fulham, S.W., printer. G. W. Lock is the first managing director, with £1,000 per annum remuneration.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Electrical Power Storage Company, Limited** (30,313).—This company's annual return was filed on August 4th. The capital is £100,500 in £5 shares (100 founders'). 66 founders' and 18,352 ordinary shares have been taken up, and 15,220 ordinary shares are considered as paid. £5 per share has been called on the founders', and £3 per share on the remaining ordinary. £10,200 5s. 1d. has been paid, including £474 5s. 1d. paid on 409 (4 founders' and 405 ordinary) shares forfeited.

**Electricity Supply Company for Spain, Limited** (29,103).—This company's annual return was filed on August 11th, when the whole capital of £100,000 in £5 shares (100 founders') was taken up. The founders' shares are considered as paid, and £99,500 has been paid on the ordinary.

**Ernest G. Denner & Co., Limited** (56,777).—This company's annual return was filed on August 9th, when 256 shares were taken up out of a capital of £5,000 in £1 shares; £255 has been paid, and £1 is in arrears.

**F. W. Smith & Co., Limited** (56,604).—This company's statutory return was filed on July 20th, when 200 shares were taken up out of a capital of £5,000 in £5 shares. £5 per share has been called, and £812 10s. paid, leaving £187 10s. in arrears.

## CITY NOTES.

### Consolidated Telephone Construction and Manufacturing Company, Limited.

Mr. C. L. W. Fitzgerald presided on Thursday last week over an extraordinary general meeting of the above company held at Winchester House, "To consider the present position of the company, and to pass such resolution or resolutions as to the continuance or closing of the company's business, or otherwise, as the meeting may determine, and if the meeting shall so determine, to pass the following resolutions:—(1) That the company be wound up voluntarily. (2) That Mr. C. L. W. Fitzgerald, Sir Alexander Armstrong, K.C.B., Mr. Arthur Henry Baker, and Mr. Henry Gowing, the present directors of the company, be the liquidators; and (3) That the remuneration of the liquidators be at the rate of £52 10s. per annum each, so long as the liquidation shall continue."

The Chairman said it would be in their recollection that efforts had been made at the past three meetings to induce the directors to place the company into liquidation, and that that course had been opposed by the board. The board, however, pledged themselves to at once inform the shareholders when they thought the time had come to take such a step. A circular was issued last year which showed that the board had an overwhelming number of votes, the figures being 109,000 for the board and 19,100 against, while 20,000 shares held by the board were not included in the 109,000. That showed them how absolutely *bond fide* was the action of the board on behalf of the shareholders in calling that extraordinary meeting to propose the voluntary liquidation of the company. They might ask what had caused that change of opinion. They must remember that they hoped a good deal from the removal of the factory to Coventry, but those hopes had unfortunately not been fulfilled. That which had really decided them was the very unsatisfactory trading account for the past year, and the lack of orders to keep the factory going. They had tried to take up various other manufactures without any success—indeed, they resulted in loss instead of a profit. In 1897 their trading profit was £2,021, and this year it was £92; but they had an increase of stock in 1898 from £7,912 to £9,260, an increase of £1,348, which was further loss as they had converted their golden sovereigns into stock which they could not sell. He found also, their cash balance on March, 1897, was £8,900, and it was now £2,100. Of that sum dividends paid amounted to £3,930, and the other sum of £3,000 had apparently gone in stock, &c. It was that which determined the board to call them together. Of course the officials and the employés of the company were anxious to go on, but personally, he was sorry to say he could not see any manufacturing outlook which would justify them in still struggling on, and he for one could not suggest to the shareholders that they should carry on the business merely to pay salaries. Their sales for the last 4½ months had been £3,100, and they had £1,700 worth of orders in hand, which was, of course, not very good. What they suggested to the shareholders was a slow liquidation, conducted with all economy. This liquidation could not be hurried if the shareholders were to derive much benefit out of it. Their business assets consisted of three items:—(1) The manufacturing business, including freehold plant and stock; (2) the private wire business; and (3) investments and book debts. They would try first to dispose of the factory as a going concern, and if unable to do that, to execute all existing orders, including contracts, some of which had a year to run, and then to sell the factory. The private wire business was now paying its way, and they were hopeful that they might sell that business as a going concern. If not, it could be carried on at small cost. Some of the contracts for these lines did not terminate until 1903. As to investments and book debts, the latter they could collect, and the dividends on the former could go to swell the amount eventually received by the shareholders. The 500 ordinary shares of the National Telephone Company, and the 1,000 United River Plate shares could be realised at a favourable opportunity. The realisation of the 2,000 6 per cent. and 10,500 8 per cent. debentures in the Anglo-Portuguese Telephone Company depended on their ability to sell that undertaking. The 20,000 preference, and 189,000 ordinary shares of the Edison Gower-Bell Telephone Company were also dependent on what the Anglo-Portuguese Telephone Company could be sold for. In connection with the Edison Gower-Bell Company, they had a law suit in Belgium which would be carried on by them to the bitter end. So far they had received about £14,000 from that action, which had lasted 10 years. They would, of course, do away with the heavy expenses, which last year amounted to £1,800, and take a smaller office. He thought in time they could return something substantial to the shareholders. Sir Alex. Armstrong had an alternative proposal—that an expert should be called in as to whether the factory could be made to pay. Of course it could be made to pay if they had the orders, but he failed to see where the manufacturing business was to come from. Here, however, he must pause, because since they last met the Telephone Committee had issued a report to the effect that the Post Office should compete with the National Telephone Company, or else that licenses should be granted to municipalities. He thought the Post Office could do little against the company, because they were already in competition, and did not get

on. If the municipalities took it up there was a possibility of them getting orders from them. In conclusion, the chairman said the board had refrained from asking for proxies, as they wished for an expression of opinion, which he asked the shareholders to give before he moved any resolution.

Mr. Woolley strongly deprecated the throwing up of the sponge, in view of the report of the Select Committee on Telephones. The pertinent question was whether their factory was conducted in an energetic and proper way, so that they were losing on their merits. He understood that their revenue from investments was increasing, and he could see no reason for putting the resolution.

Mr. Spencer asked whether the sales in the past three months compared favourably with those in the corresponding period of last year.

The Chairman: £500 more.

Sir Alex. Armstrong said he regretted he was not in accord with his colleagues on that occasion. He thought it was a premature step to wind up, and he advocated calling in an expert to go thoroughly into the thing and to reorganise the company. He believed they had good prospects, and that they would have staunch friends in the Post Office, and he thought they would be well supported by the municipilities.

Mr. Buck, who said he advocated liquidation two years ago, considered now that liquidation would be wrong. He had altered his opinion solely on account of the finding of the Select Committee on Telephones, for he considered if municipalities were granted licenses, they would get a fair share of the work.

Mr. Stoop said that compared with telephone construction companies in other countries, their business was extremely small. He thought the outcome would be that the Government would take up the business of telephones, but would only use such competition to lower the terms of the National Telephone Company. There was no guarantee that if licenses were granted that orders would come to them, and he advocated liquidation.

After a lengthy discussion, it was agreed, on the motion of Sir Alex. Armstrong, seconded by Mr. Woolley, that an inquiry be made by a committee consisting of Messrs. Stoop, Lawson, and Woolley (shareholders), and Sir Alex. Armstrong and Mr. Grëving (directors), with the assistance of an expert, into the prospects of the company, and that the committee should report at a future meeting to be called by the chairman.

## Improved Electric Glow Lamp Company.

Mr. Henry F. Joel presided on Friday over the second annual general meeting of the above company, held at the Cannon Street Hotel.

The Chairman, in moving the adoption of the report, having apologised for the absence of several members of the board, said the balance-sheet showed that the company was now in a healthy and prosperous condition, with a balance on the right side, and he congratulated the shareholders on the fact that their company, with an entirely novel, although very beautiful and useful form of electric lamp, had so quickly been able to establish their business and to become a paying concern. He was pleased to say that the sale of the company's patent lamps was increasing very rapidly, and indications showed that the present year's business would be more than double that of last year. The directors were pushing the business to the best of their ability; they had appointed many agents in the United Kingdom, and also in different countries of the world. Quite recently they had arranged for agents and sub agents in every principal town and district in Australasia, and were also doing the same in other of the colonies. The present balance-sheet showed that they had written off £10,765 4s. 2d. This amount consisted of £3,863 9s. 9d carried over from 1897, and also suspense accounts to the extent of nearly £7,000, which appeared in the balance-sheet of 1897. The directors might have spread the writing off the suspense accounts over a number of years, and that would have enabled them to pay a small dividend this year; but after careful consideration, they thought it advisable to clear them off at once, and so place the company in a sound financial condition. Any profits now earned in the present year would be available for paying dividends, whilst the capital of the company remained intact, and owing to the increase of the business, all the available ready money was wanted. Although the amount written off appeared to be a large one, it should not be taken as a loss in trading; the greater part was expended in establishing the company's business, viz., advertising, exhibitions, arranging agencies, &c. The directors were very pleased to say that these initial expenses would not be continued in the future, the advantages of the lamps were becoming well known and appreciated, the company's business was now firmly established as a commercial concern, a trade connection had been made, and the company had over 1,000 customers on their books, with many agents under contract to take large numbers of lamps per annum. The management of the company had been entirely reorganised during the past six months, unnecessary expenses had been cut down, a more efficient staff engaged under the management of an executive committee of the directors; the policy of the directors now was:—1. To make their business pay as an industrial concern; and 2. To uphold and strengthen their patents, as well as to sell their foreign patents to the best advantage of the shareholders. The company's lamps were patented in all the principal countries of the world, and it might surprise the shareholders to know that they possessed over 50 patents, as well as registered designs. To show the value of these patents, it need only be mentioned that the directors had recently sold the French, Belgian, and Spanish patents for £25,000, and of this the substantial amount of £12,500 had been received in cash, which had enabled the directors to provide for and write off the suspense and other accounts, and to place the company on its present footing. The American, German, and Austrian patents were now under offer at most advantageous terms, which if realised would pay a dividend of over 50 per cent. on the capital of the company. The directors had also sold their Swiss patents at a considerable profit. The directors had granted licenses for the manufacture of their lamps, amongst others, to the Edison-Swan Company and the Sunbeam Lamp Company. All contractors to the company were now bound under license to recognise the validity of the company's patents, and the directors were also granting licenses for sale under royalties. The policy of granting licenses safeguards the patents and property of the company. As a part of their new policy, the directors had introduced new forms of opal reflector lamps, they had prepared and issued many thousands of the new and very effective illustrated price catalogue, and the directors had obtained new patents for the manufacture of these opal reflector lamps, as well as an improved process of silvering the lamps, thus the directors were meeting the requirements of their customers, and at the same time were adding to the value of their patents. There was already a very large demand for these lamps, and the directors, by securing the patents for their manufacture, had placed the company in a position to almost monopolise the trade in the lamps. The directors had arranged for the manufacture of their lamps on a very large scale, and they felt certain of a very large turnover. The directors were now prepared to supply their special shaped lamps as clear glass lamps in any voltage, to meet the requirements of their customers. As a result of their progressive policy, and to enable them to carry on their increased business, the directors would require additional working capital. The working capital of the company was a small one—about £20,000 only—and of this nearly £12,000 was locked up in stock necessary to enable them to supply orders quickly. The directors appealed to the shareholders to come forward to assist them in their efforts to make their property more valuable, and ask the shareholders to take the 12,500 £1 shares now to be issued at par. The directors could create other forms of shares, but as this would place the original shareholders at a disadvantage, they submitted those ordinary shares for issue before taking any other course. The shareholders might rely upon the directors safeguarding their interests and doing all that is possible for the advantage of the company.

Mr. Speakman seconded the motion, which was agreed to unanimously.

## The Chloride Electrical Storage Syndicate, Limited.

The ordinary annual general meeting of the above company was held at Clifton Junction, nr. Manchester, on Tuesday, the 19th inst., F. H. Bowman, Esq., D.Sc., F.R.S, in the chair. The notice convening the meeting having been read by the secretary, the directors' report and statements of accounts for the year ending June 30th, 1898, were received and adopted. A dividend at the rate of 7 per cent. per annum was declared on the "A" shares for the year ended June, 1898. The retiring director and auditors were re-elected, and a vote of thanks passed to the chairman and directors.

**Aluminium Company, Limited.**—The report for the 12 months ended June 30th shows a gross profit of £17,190. This sum, together with £1,447 brought forward, less the amount of £1,157, which remained to be written off the expenses of issuing the new debenture stock, leaves a balance of £6,938, after providing for debenture interest and fixed charges. The directors recommend a dividend of £10 per cent. for the year on the "A" shares, which will absorb £6,000, leaving £938 to be carried forward.

**Stock Exchange Notices.**—The Stock Exchange Committee have ordered the undermentioned securities to be quoted in the Official List:—Electric Construction Company, Limited, 8,657 7 per cent. cumulative preference shares of £2 each, fully paid, Nos. 16,344 to 25,000.

Applications have been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to:—London Electric Supply Corporation, Limited—Ordinary shares of £3 each; 6 per cent. preference shares of £5 each; and 5 per cent. mortgage debentures.

## TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending August 19th, 1898, were £3,941 4s. 2d.; corresponding period 1897, £2,691 1s. 1d.; increase, £1,250 3s. 1d.

The City and South London Railway Company.—The receipts for the week ending August 21st, 1898, were £1,044; week ending August 22nd, 1897, £1,021; increase, £23; total receipts for half-year, 1898, £7,829; corresponding period, 1897, £7,314; increase, £515.

The Dover Corporation Electric Tramways.—The receipts for the week ending August 20th, 1898, were £272 15s. 11d.; total receipts to August 20th, 1898, £4,794 2s. 4d.

The Dublin Southern District (Electric) Tramways Company.—The receipts for the week ending August 19th, 1898, were £1,250 17s.; corresponding week last year, £722 8s. 6d.; increase, £528 8s. 6d.; passengers carried, 167,792; corresponding week last year, 106,568; aggregate to date, £7,938 14s. 6d.; aggregate to date last year, £6,068 17s. 9d.; increase to date, £1,869 16s. 9d.; mileage open, 9 miles, against 8 miles last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending August 21st, 1898, amounted to £1,664; corresponding week last year, £1,518; increase, £146.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending August 19th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,584.

## SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. † | Dividends for the last three years. 1895. | 1896. | 1897. | Closing Quotation, August 17th. | Closing Quotation, August 24th. | Business done during week ended August 24th, 1898. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 137,400*l* | African Direct Telegraph, 4 % Debs. ... ... ... | 100 | 4 % | ... | ... | 100 —104 | 100 —104 | ... | ... |
| 25,000 | Amazon Telegraph, shares ... ... ... ... | 10 | ... | ... | ... | 6 — 7 | 6 — 7 | ... | ... |
| 125,000 | Do. do. 5 % Debs. Red. ... ... ... ... | 100 | ... | ... | ... | 92 — 95 | 92 — 95 | ... | ... |
| 923,960*l* | Anglo-American Telegraph ... ... ... ... | Stock | £2 9s | £2 13s | 3 % | 64 — 67 | 64 — 67 | 64½ | ... |
| 3,038,020*l* | Do. do. 6 % Pref. ... ... ... | Stock | £4 18s | £5 6s | 6 % | 115 —116 | 115 —116 | 116 | 115 |
| 3,038,020*l* | Do. do. Deferred... ... ... ... | Stock | ... | ... | ... | 15 — 15½ | 15¼— 15⅜ | 15⅛ | 15⅛ |
| 130,000 | Brazilian Submarine Telegraph ... ... ... ... | 10 | 7 % | 7 % | 7 % | 15¾— 16¼ | 15¾— 16¼ | 16⅛ | 15⅞ |
| 75,000*l* | Do. do. 5 % Debs. 2nd series, 1906 ... | 100 | 5 % | ... | ... | 111 —115 | 111 —115 | ... | ... |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 ... ... ... ... | 5 | 4 % | 4 % | 4 % | 2¾— 3¼xd | 2¾— 3¼ | ... | ... |
| 10,000,000$ | Commercial Cable ... ... ... ... ... ... | $100 | 7 % | 8 % | 8 % | 180 —190 | 180 —190 | ... | ... |
| 918,297*l* | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | ... | ... | ... | 104 —106 | 105 —107 | 106¼ | 105½ |
| 224,850 | Consolidated Telephone Construction and Manufacturing | 10/- | 1½ % | 2 % | ... | 1/16— 3/16 | 1/16— 1/16 | ... | ... |
| 16,000 | Cuba Telegraph ... ... ... ... ... ... | 10 | 8 % | 8 % | 7 % | 7 — 8 | 7½— 8½ | 8¼ | 7⅞ |
| 6,000 | Do. 10 % Pref. ... ... ... ... ... | 10 | 10 % | 10 % | 10 % | 15 — 16 | 15 — 16 | ... | ... |
| 12,931 | Direct Spanish Telegraph ... ... ... ... ... | 5 | 4 % | 4 % | 4 % | 4 — 5 | 4 — 5 | ... | ... |
| 6,000 | Do. do. 10 % Cum. Pref. ... ... ... | 5 | 10 % | 10 % | 10 % | 10 — 11 | 10 — 11 | ... | ... |
| 30,000*l* | Do. do. 4½ % Debs., Nos. 1 to 6,000 ... | 50 | 4½ % | 4½ % | 4½ % | 102 —105% | 102 —105% | ... | ... |
| 60,710*l* | Direct United States Cable ... ... ... ... ... | 20 | 2¼ % | 2½ % | ... | 11½— 11⅝ | 11½— 11⅝ | 11¾ | 11½ |
| 120,000 | Direct West India Cable, 4½ % Reg. Deb. ... ... | 100 | ... | ... | ... | 100—103 | 100 —103 | ... | ... |
| 400,000 | Eastern Telegraph, Nos. 1 to 400,000 ... ... ... | 10 | 6½ % | 6½ % | 7 % | 17½— 17¾ | 17½— 18 | 17⅝ | 17⅜ |
| 1,295,000 | Do. 3½ % Pref. Stock ... ... ... | 100 | ... | ... | ... | 102 —106 | 103 —106 | 105 | 104 |
| 89,900 | Do. 5 % Debs., repayable August, 1899 ... | 100 | 5 % | 5 % | 5 % | 100 —103 | 100 —103 | ... | ... |
| 1,302,615*l* | Do. 4 % Mort. Deb. Stock Red. ... ... | Stock | 4 % | 4 % | 4 % | 124 —128 | 124 —128 | 124½ | ... |
| 250,000 | Eastern Extension, Australasia, and China Telegraph ... | 10 | 7 % | 7 % | 7 % | 17¼— 17¾ | 17¼— 17¾ | 17 11/16 | 17⅞ |
| 25,200*l* | Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326 | 100 | 5 % | 5 % | 5 % | 99 —103 | 99 —103 | ... | ... |
| 100,500*l* | Do. do. Bearer, 1,050—3,975, 4,327—6,400 | 100 | 5 % | 5 % | 5 % | 100 —103 | 100 —103 | ... | ... |
| 320,000*l* | Do. 4 % Deb. Stock ... ... ... ... ... | Stock | 4 % | 4 % | 4 % | 123 —127 | 123 —127 | ... | ... |
| 35,100*l* | Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343 | 100 | 5 % | 5 % | ... | 99 —103 | 99 —103 | ... | ... |
| 46,500*l* | Do. do. do. to bearer, 2,344 to 5,500 | 100 | 5 % | 5 % | ... | 100 —103 | 100 —103 | ... | ... |
| 300,000*l* | Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909 | 100 | 4 % | 4 % | ... | 101 —104 | 102 —105 | 103½ | ... |
| 200,000*l* | Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000 | 25 | 4 % | 4 % | ... | 104 —107% | 104 —107% | ... | ... |
| 180,227 | Globe Telegraph and Trust ... ... ... ... ... | 10 | 4½ % | 4½ % | 4½ % | 11¾— 12¼ | 11¾— 12¼ | 12⅛ | 11 13/16 |
| 180,042 | Do. do. 6 % Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 16½— 17 | 16½— 17 | 17 | ... |
| 150,000 | Great Northern Telegraph, of Copenhagen... ... ... | 10 | 10 % | 10 % | 10 % | 29 — 30 | 29 — 30 | 29 1/16 | 29⅛ |
| 160,000*l* | Do. do. do. do. 5 % Debs. ... | 100 | 5 % | 5 % | 5 % | 102 —105 | 103 —106 | 105 | 104½ |
| 97,000 | Halifax & Bermuda Cable, 4½ % 1st. Mt. Dbs., w'n. 1-1,200, rd. | 100 | ... | ... | ... | 100 —104 | 100 —104 | ... | ... |
| 17,000 | Indo-European Telegraph ... ... ... ... ... | 25 | 10 % | 10 % | 10 % | 51 — 54 | 51 — 54 | 53 | ... |
| 100,000*l* | London Platino-Brazilian Telegraph, 6 % Debs. ... ... | 100 | 6 % | 6 % | 6 % | 110 —113 | 110 —113 | ... | ... |
| 28,000 | Montevideo Telephone, 6 % Pref., Nos. 1 to 28,000 ... | 5 | 4 % | 4 % | 4 % | 2¼— 2⅜ | 2¼— 2⅜ | ... | ... |
| 484,597 | National Telephone, 1 to 484,597 ... ... ... ... | 5 | 5½ % | 5½ % | 6 % | 5⅛— 5⅜ | 5⅛— 5⅜ | 5 5/16 | 5 1/16 |
| 15,000 | Do. 6 % Cum. 1st Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 15 — 17 | 14 — 16 | ... | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 15 — 17 | 15 — 17 | ... | ... |
| 250,000 | Do. 5 % Non-cum. 3rd Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5⅛— 5⅜ | 5¼— 5½ | 5½ | ... |
| 1,329,471*l* | Do. 3½ % Deb. Stock Red. ... ... | Stock | 3½ % | 3½ % | 3½ % | 100—105 | 100 —105 | 104 | 103½ |
| 171,504 | Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid | 1 | 5 % | 5 % | 5 % | ⅝— ¾ | ⅝— ¾ | ... | ... |
| 100,000*l* | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ... | 100 | 4 % | 4 % | 4 % | 105 —108 | 105 —108 | ... | ... |
| 11,839 | Reuter's ... ... ... ... ... ... ... ... | 8 | 5 % | 5 % | 5 % | 8 — 9 | 8 — 9 | ... | ... |
| 3,381 | Submarine Cables Trust ... ... ... ... ... | Cert. | ... | ... | ... | 136 —141 | 136 —141 | ... | ... |
| 58,000 | United River Plate Telephone ... ... ... ... | 5 | 4 % | 5 % | 6 % | 4¼— 4¾ | 4¼— 4¾ | ... | ... |
| 146,733*l* | Do. do. 5 % Debs. ... ... ... | Stock | 5 % | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 15,609 | West African Telegraph, 7,501 to 23,109 ... ... ... | 10 | 4 % | *nil* | *nil* | 3½— 4½ | 3½— 4½ | ... | ... |
| 213,400*l* | Do. do. 5 % Debs. ... ... ... ... | 100 | 5 % | 5 % | 5 % | 100 —103 | 100 —103 | ... | ... |
| 30,008 | West Coast of America, Nos. 1—30,000 and 53,001—53,008 | 2½ | ... | ... | ... | ¼— ¾ | ¼— ¾ | ... | ... |
| 150,000 | Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel. | 100 | ... | ... | ... | 104 —107 | 104 —107 | 106 | ... |
| 64,269 | Western and Brazilian Telegraph ... ... ... ... | 15 | 3 % | 2 % | 3½ % | 12¼— 12⅝ | 12¼— 12⅝ | 12⅝ | 12⅜ |
| 33,129 | Do. do. do. 5 % Pref. Ord. ... ... | 7½ | 5 % | 5 % | 5 % | 8 — 8½ | 8 — 8½ | 8⅝ | ... |
| 33,129 | Do. do. do. Def. Ord. ... ... | 7½ | 1 % | *nil* | ½ % | 4 — 4½ | 4 — 4½ | 4¼ | 4⅛ |
| 389,521 | Do. do. do. 4 % Deb. Stock Red. ... | Stock | ... | ... | ... | 107 —110 | 107 —110 | 108 | ... |
| 88,321 | West India and Panama Telegraph ... ... ... ... | 10 | ⅛ % | 1 % | ⅜ % | ⅜— 1 | ⅞— 1⅛ | 1 1/16 | ⅞ |
| 34,563 | Do. do. do. 6 % Cum. 1st Pref. ... | 10 | 6 % | 6 % | 6 % | 8¾— 9¼ | 8¾— 9¼ | 9¼ | 8 11/16 |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. ... | 10 | 6 % | 6 % | 6 % | 6 — 8 | 6 — 8 | 7½ | ... |
| 80,000*l* | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | 5 % | 5 % | 5 % | 104 —107 | 105 —108 | ... | ... |
| 1,163,000$ | Western Union of U.S. Telegraph, 7 % 1st Mort. Bonds | $1000 | 7 % | 7 % | 7 % | 105 —110 | 105 —110 | ... | ... |
| 160,100*l* | Do. do. do. 6 % Ster. Bonds ... | 100 | 6 % | 6 % | 6 % | 100 —105 | 100 —105 | ... | ... |

## ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30,000 | Charing Cross and Strand Electricity Supply ... ... | 5 | 5 % | 6 % | 7 % | 12 — 13 xd | 12 — 13 | ... | ... |
| 20,000 | Do. do. do. do. 4½ % Cum. Pref. | 5 | ... | ... | ... | 5¾— 6¼xd | 6 — 6½ | ... | ... |
| 26,000 | *Chelsea Electricity Supply, Ord., Nos. 1 to 10,277... ... | 5 | 5 % | 5 % | 6 % | 8½— 9½ | 8½— 9½ | 9⅛ | 8⅞ |
| 60,000 | Do. do. do. 4½ % Deb. Stock Red.... | Stock | 4½ % | 4½ % | 4½ % | 113 —115 | 113 —115 | 111 | ... |
| 50,000 | City of London Electric Lighting, Ord. 40,001—90,000 ... | 10 | 5 % | 7 % | 10 % | 25 — 26 | 25 — 26 | 25½ | 25 |
| 10,000 | Do. Prov. Certs. Nos. 90,001 to 100,000 £5 ... | 10 | ... | ... | ... | 24½— 25½ | 25 — 26 | ... | ... |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 ... ... ... | 10 | 6 % | 6 % | 6 % | 16½— 17½ | 16½— 17½ | 16 11/16 | ... |
| 400,000 | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | 5 % | 5 % | 5 % | 125 — 130 | 125 —130 | 129 | 128 |
| 30,000 | County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000 | 10 | *nil* | *nil* | *nil* | 13 — 14 | 13 — 14 | ... | ... |
| 10,000 | Do. do. do. Nos. 30,001 to 40,000 £6 paid. | 10 | ... | ... | ... | 8½— 9½ | 8½— 9½ | ... | ... |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | 6 % | 6 % | 14 — 15 | 14 — 15 | ... | ... |
| 17,400 | Edmundsons Elec. Corp., Ord. Shares 1—17,400 ... ... | 5 | ... | ... | 5 % | 5 — 5½ | 5 — 5½ | ... | ... |
| 10,000 | House-to-House Electric Light Supply, Ord., 101 to 10,100 | 5 | ... | ... | 4 % | 8½— 9½ | 8½— 9½ | ... | ... |
| 10,000 | Do. do. 7 % Cum. Pref. ... | 5 | 7 % | 7 % | 7 % | 9½— 10½ | 9½— 10½ | ... | ... |
| 62,400 | *Metropolitan Electric Supply, 101 to 62,500 ... ... | 10 | 4 % | 5 % | 6 % | 15½— 16½ | 16 — 17 | 16½ | 16 |
| 220,000*l* | Do. 4½ % First Mortgage Debenture Stock | ... | 4½ % | 4½ % | 4½ % | 116 —120 | 116 —120 | ... | ... |
| 6,452 | Notting Hill Electric Lighting ... ... ... ... | 10 | 2 % | 4 % | 6 % | 15 — 16 | 15 — 16 | ... | ... |
| 31,980 | *St. James's and Pall Mall Electric Light, Ord. ... ... | 5 | 7½ % | 10½ % | 14½ % | 16 — 17 | 16½— 17½ | 17¼ | 16 11/16 |
| 20,000 | Do. do. 7 % Pref., 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 9 — 10 | 9 — 10 | ... | ... |
| 50,000 | Do. do. 4 % Deb. Stock Red. ... | Stock | ... | ... | 4 % | 105 —108 | 105 —108 | ... | ... |
| 43,341 | South London Electricity Supply, Ord., £2 paid ... ... | 5 | ... | ... | ... | 3 — 3¼ | 3 — 3¼ | ... | ... |
| 79,900 | Westminster Electric Supply, Ord., 101 to 80,000 ... | 5 | 7 % | 9 % | 12 % | 15 — 16 xd | 15½— 16½ | 16¼ | 16 |

* Subject to Founder's Shares.
† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

## SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1895. | 1896. | 1897. | Closing Quotation August 17th. | Closing Quotation August 24th. | Business done during week ended Aug. 24th, 1898. Highest. | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 30,000 | British Electric Traction ... ... ... ... ... | 10 | ... | ... | ... | 16½— 17 | 16½— 17 | 16½ | ... |
| 10,000 | Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.) | 10 | ... | ... | ... | 10½— 11 | 13 — 14 | 13⅞ | 13⅜ |
| 90,000 | Brush Elecl. Enging., Ord., 1 to 90,000 ... ... ... | 3 | 2½% | *nil* | *nil* | 1⅜— 2 | 1⅜— 2 | 1 15/16 | 1¾ |
| 90,000 | Do. do. Non-cum. 6 % Pref., 1 to 90,000 | 2 | 3 % | *nil* | 4 % | 2⅛— 2⅜ | 2⅛— 2⅜ | 2¼ | 2⅛ |
| 125,000*l* | Do. do. 4½ % Perp. Deb. Stock ... | Stock | ... | ... | ... | 110 —114 | 110 —114 | ... | ... |
| 50,000 | Do. do. 4½ % 2nd Deb. Stock Red. ... | Stock | ... | ... | ... | 102—105 | 102 —105 | ... | ... |
| 19,894 | Central London Railway, Ord. Shares ... ... ... | 10 | ... | ... | ... | 9⅜— 10¼ | 9⅜— 10¼ | 10 3/16 | 10 1/16 |
| 129,179 | Do. do. do. £6 paid ... ... | 10 | ... | ... | ... | 5¾— 6¼ | 5¾— 6¼ | ... | ... |
| 59,254 | Do. do. Pref. half-shares £1 paid ... | ... | ... | ... | ... | 1¼— 1⅜ | 1¼— 1⅜ | ... | ... |
| 67,680 | Do. do. Def. do. £5 paid ... | ... | ... | ... | ... | 4¼— 4¾ | 4¼— 4¾ | 4½ | ... |
| 630,000*l* | City and South London Railway ... ... ... ... | Stock | 1 3/16 % | 1 9/16 % | 1⅞% | 70 — 72 | 70 — 72 | 71 | 70 |
| 22,500 | Do. do. Ord. shares, Nos. 1 to 22,500 £3 pd. | 10 | ... | ... | ... | 2¾— 3¼ | 2¾— 3¼ | ... | ... |
| 32,098 | Crompton & Co., Nos. 1 to 32,098 ... ... ... ... | 3 | ... | ... | ... | 1¾— 2¼ | 1¾— 2¼ | ... | ... |
| 82,850 | Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red. | ... | ... | ... | ... | 89 — 94 | 89 — 94 | ... | ... |
| 99,261 | Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261 | 5 | 5 % | 5⅛% | 6 % | 2¼— 2⅜xd | 2¼— 2⅜ | 2 7/16 | ... |
| 17,139 | Do. do. do. "A" Shares, 01—017,139 | 5 | 5 % | 5½% | 6 % | 4 — 5 xd | 4 — 5 | ... | ... |
| 194,023 | Do. do. do. 4 % Deb. Stock Red. ... | 100 | ... | ... | ... | 101 —103 | 101 —103 | ... | ... |
| 110,000 | Electric Construction, 1 to 110,000 ... ... ... ... | 2 | 5 % | 6 % | 6 % | 2⅜— 2⅝ | 2¼— 2½ | 2 7/16 | 2 5/16 |
| 16,343 | Do. do. 7 % Cum. Pref., 1 to 16,343 ... | 2 | 7 % | 7 % | 7 % | 3 — 3½ | 3 — 3½ | 3 3/16 | 3 1/16 |
| 111,100 | Do. do. 4% Perp. 1st Mort. Deb. Stock ... | Stock | ... | ... | ... | 105 —107 | 105 —107 | 105 | ... |
| 91,196 | Elmore's Patent Copper Depositing, 1 to 70,000 ... ... | 2 | ... | ... | ... | ⅜— ⅝ | ⅜— ⅝ | ... | ... |
| 67,275 | Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm. | 2 | ... | ... | ... | ¼— ½ | ¼— ½ | ¼ | ... |
| 9,600*l* | Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ... | 10 | 10½% | 7 % | 7 % | 9 — 11 | 10 — 12 | ... | ... |
| 12,500 | Henley's (W. T.) Telegraph Works, Ord. ... ... ... | 10 | 8 % | 10 % | 12 % | 21 — 22 | 21 — 22 | 21¾ | 21⅝ |
| 3,000 | Do. do. do. 7 % Pref. ... ... | 10 | 7 % | 7 % | 7 % | 18½— 19½ | 18½— 19½ | ... | ... |
| 50,000 | Do. do. do. 4½ Mort. Deb. Stock... | Stock | 4½% | 4½% | 4½% | 112 —117 | 112 —117 | 116 | ... |
| 50,000 | India-Rubber, Gutta-Percha and Telegraph Works ... | 10 | 10 % | 10 % | 10 % | 21½— 22½ | 22 — 23 | 22½ | 22 3/16 |
| 300,000 | Do. do. do. 4 % 1st Mort. Debs. | 100 | ... | ... | ... | 102 —106 | 102 —106 | 106 | ... |
| 37,500 | †Liverpool Overhead Railway, Ord. ... ... ... ... | 10 | 2⅞% | 2⅞% | 3¼% | 10 — 10⅛ | 10 — 10⅛ | ... | ... |
| 10,000 | † Do. do. Pref., £10 paid ... ... | 10 | 5 % | 5 % | 5 % | 15½— 16 | 15½— 16 | ... | ... |
| 37,350 | Telegraph Construction and Maintenance ... ... ... | 12 | 15 % | 15 % | 15 % | 37 — 41 | 37 — 41 | 40 | 38½ |
| 150,000 | Do. do. do. 5 % Bonds, red. 1899 | 100 | 5 % | 5 % | 5 % | 100 —103 | 100 —103 | ... | ... |
| 540,000*l* | Waterloo and City Railway, Ord. Stock ... ... ... | 100 | ... | ... | ... | 125 —130 | 126 —131 | 129 | 128⅝ |

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

### LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.
British Aluminium, Ordinary, 10½—11; 7 % Pref., 12¼—12⅜.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 14—16; 1st Preference Cumulative 6%, £5 (fully paid), 8—8½. Debentures, 105—108. Dividend, 1897, on Ordinary Shares 10%.
London Electric Supply Corporation, £5 Ordinary, 3¾—4¼.
National Electric Free Wiring, 5s. paid, 1/16 dis to 1/16 pm.
*T. Parker, £10 (fully paid), 13½.
Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6%.

* From Birmingham Share List.

**Bank rate of discount 2½ per cent. (June 30th, 1898).**

### MARKET QUOTATIONS, Wednesday, August 24th.

| CHEMICALS, &c. | This week. | Last week. | Increase or Decrease. |
|---|---|---|---|
| *a* Acid, Hydrochloric .. .. per cwt. | 5/- | 5/- | .. |
| *a* „ Nitric .. .. .. per cwt. | 22/- | 22/- | .. |
| *a* „ Oxalic .. .. .. per cwt. | 32/- | 33/- | .. |
| *a* „ Sulphuric .. .. .. per cwt. | 5/6 | 5/6 | .. |
| *a* Ammoniac, Sal .. .. .. per ton | 37/- | 37/- | .. |
| *a* Ammonia, Muriate (grey) .. per ton | £19 | £19 | .. |
| *a* „ „ (white) .. per ton | £26 | £26 | .. |
| *a* Bleaching powder .. .. per ton | £6 15 | £6 15 | .. |
| *a* Bisulphide of Carbon .. .. per ton | £15 | £15 | .. |
| *a* Borax .. .. .. per ton | £14 | £14 | .. |
| *a* Benzole (90%) .. .. .. per gal. | 7/- | 7/- | .. |
| *a* „ (50/90%) .. .. per gal. | 5/6 | 5/6 | .. |
| *a* Copper Sulphate .. .. .. per ton | £16 10 | £16 10 | .. |
| *a* Lead, Nitrate .. .. .. per ton | £23 | £23 | .. |
| *a* „ White Sugar .. .. per ton | £30 | £30 | .. |
| *a* „ Peroxide .. .. .. per ton | £27 | £27 | .. |
| *a* Methylated Spirit .. .. per gal. | 2/9 | 2/9 | .. |
| *a* Naphtha, Solvent (90% at 160° C.) .. .. .. per gal. | 5/6 | 5/6 | .. |
| *a* Potash, Bichromate, in casks.. per lb. | 4d. | 4d. | .. |
| *a* „ Caustic (75/80%) .. per ton | £24 | £24 | .. |
| *a* „ Bisulphate .. .. per ton | £35 | £35 | .. |
| *a* Shellac .. .. .. .. per cwt. | 64/- | 64/- | .. |
| *a* Sulphate of Magnesia .. .. per ton | £4 10 | £4 10 | .. |
| *a* Sulphur, Sublimed Flowers .. per ton | £6 10 | £6 10 | .. |
| *a* „ Recovered .. .. per ton | £5 10 | £5 10 | .. |
| *a* „ Lump .. .. .. per ton | £5 | £5 | .. |
| *a* Soda, Caustic (white 70%) .. per ton | £8 15 | £8 15 | .. |
| *a* „ Crystals .. .. .. per ton | £3 | £3 | .. |
| *a* „ Bichromate, casks .. per lb. | 3½d. | 3½d. | .. |

| METALS, &c. | This week. | Last week. | Increase or Decrease. |
|---|---|---|---|
| *b* Aluminium Wire, in ton lots .. per ton | £224 | £224 | .. |
| *b* „ Sheet, in ton lots.. per ton | £191 | £191 | .. |
| *c* Brass (rolled metal 2" to 12") basis per lb. | 6¼d. | .. | .. |
| *c* „ Tube (brazed) .. .. per lb. | 8¾d. | .. | .. |
| *c* „ Wire, basis .. .. per lb. | 6¼d. | .. | .. |
| China Clay.. .. .. .. per ton | .. | .. | .. |
| *d* Carbon (graphite) .. .. per ton | .. | .. | .. |
| *e* Charcoal .. .. .. per ton | .. | .. | .. |
| *f* Ebonite Rod .. .. .. per lb. | 3/- | 3/- | .. |
| *f* „ Sheet .. .. .. per lb. | 5/- | 5/- | .. |
| *g* Copper Bars .. .. .. per ton | £62 | £62 | .. |
| *g* „ Wire (basis price) .. per lb. | 7½d. | 7½d. | .. |
| *g* „ Sheet .. .. .. per ton | £62 | £62 | .. |
| *g* „ Rod .. .. .. per ton | £62 | £62 | .. |
| *n* German Silver Wire .. .. per lb. | 1/6 | 1/6 | .. |
| *h* Gutta-percha, fine .. .. per lb. | 5/3 | 5/3 | .. |
| *h* India-rubber, Para fine .. per lb. | 4/4½ | 4/4½ to 4/5 | .. |
| *i* Iron, Charcoal Sheets .. .. per ton | £18 | £18 | .. |
| *i* „ Pig (Cleveland warrants) per ton | 42/1½ | 41/11½ | 2d. inc. |
| *i* „ Forgings, according to size per ton | From £11 | From £11 | .. |
| *i* „ Scrap, heavy .. .. per ton | 45/- | 45/- | .. |
| *i* „ Wire galvanised No. 8 .. per ton | £8 15 | £8 15 | .. |
| *g* Lead, English Ingot .. .. per ton | £13 | £13 | .. |
| *g* „ „ Sheet .. .. per ton | £13 17 6 | £14 | 2/6 dec. |
| *l* Mica .. .. .. .. per lb. | 5/6 | 5/6 | .. |
| *m* Manganin Wire No. 28.. .. per lb. | 8/- | 8/- | .. |
| *g* Mercury .. .. .. .. per bottle | £7 12 | £7 12 | .. |
| *o* Platinum .. .. .. .. per oz. | £3 16 | £3 10 | 6s. inc. |
| *i* Steel, Magnet, acodng. to descptn. pr tn | From £15 | to £40 | .. |
| *i* Steel, Magnet, in bars .. .. | £58 | £58 | .. |
| *g* Tin, block .. .. .. .. per ton | £76 10 | £77 | 10s. dec. |
| *g* „ foil .. .. .. .. per lb. | 1/2 | 1/2 | .. |
| *j* Yarns, Cotton .. .. .. per lb. | .. | .. | .. |
| *j* „ Flax, 6 or 8 lea... .. per lb. | 3⅜d. | 3⅜d. | .. |
| *j* „ Hemp, 3 ply 10 lbs. .. per lb. | 3½d. | 3½d. | .. |
| *j* „ „ Russian, 10 lbs. .. per lb. | 4½d. | 4½d. | .. |
| *j* „ Jute, 180 lbs. rove .. per ton | £11 | £11 | .. |
| *j* „ Manila, 24 thread .. per ton | £29 | £29 | .. |
| *k* Zinc, Sht. (Vielle Montagne brd.) per ton | £24 | £24 | .. |

*a* Quotations supplied by Messrs. G. Boor & Co.
*b* „ „ „ The British Aluminium Co., Ltd.
*c* „ „ „ Messrs. Thos. Bolton & Sons.
*d* „ „ „ „
*e* „ „ „ „
*f* „ „ „ The India-Rubber, G.-P., and Teleg. Works Co. Ltd
*g* „ „ „ Messrs. James & Shakspeare.
*h* „ „ „ „ Jackson & Till.
*i* Quotations supplied by Messrs. Bolling & Lowe.
*j* „ „ „ „ Henry C. Yeo & Co.
*k* „ „ „ „ Morris Ashby, Limited.
*l* „ „ „ „ Sanders, Wake & Co.
*m* „ „ „ „ W. T. Glover & Co., Ltd.
*n* „ „ „ „ P. Ormiston & Sons.
*o* „ „ „ „ Johnson, Matthey & Co.

## STEAM PIPING.

There is a rather suggestive article on steam piping in the *Engineering Magazine* from the pen of Mr. W. Cooper. Attention is called to the great study devoted on the one hand to steam boilers, on the other hand to steam engines; to the two ends in fact of the steam making and using chain, while nothing has been done for the intermediate link—the steam pipe. Yet there is a vast field for the exercise of engineering judgment in the proportion and design of pipes. One of the arguments often used in favour of large steam pipes is, that the pressure at its two terminals, the engine and boiler, may be nearly equal. The author shows, and very properly, that if a steam pipe is steady, is not set in violent vibration, and if it be properly protected, there can be no loss of energy from the pipe. There can be no loss due simply to reduction of pressure in the passage through the pipe because the reduction of pressure is due to friction and can only result in superheating, which may be a real benefit. At the same time there is no occasion to make pipes rough inside and so cause friction. If we can afford to lose any pressure we may as well do so in smooth pipes, and lose the pressure by reducing the size of the pipe. Obviously there is every reason to have steam pipes as small as possible. Their first cost will be less to begin with. Secondly, they will lose correspondingly less by external radiation; and they will cost less to cover with protecting coverings.

It ought not to be very costly to grind out the roughness of a steam pipe by means of a revolving emery wheel, and Mr. Cooper suggests a smooth internal enamel.

As loss of pressure varies with the square of the velocity of flow, weight for weight therefore, high pressure steam requires smaller pipes than low pressure steam. As boilers practically evaporate equal weights of steam, whatever the pressure, the steam piping may be reduced in diameter when a given boiler carries higher pressure steam. When, for example, a stop valve of 8 inches is big enough for a boiler at 50 lbs. gauge pressure, the same boiler at 115 lbs. gauge pressure could be worked with 6-inch valve and pipes. Exactly the same reasoning applies to safety valve proportions as was shown by the report of the committee on safety valves many years ago, a report now generally forgotten, though full of interest and very valuable.

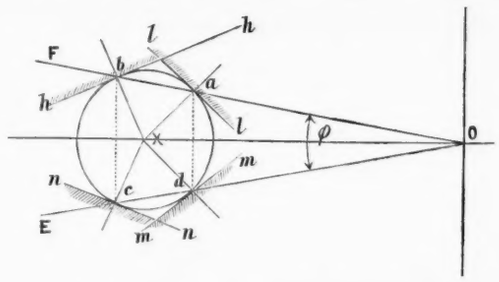
The author points out the mistake of drawing steam directly from the pipes into the cylinder of an engine. This is especially bad when such cylinder is large, and just as in the air vessel of a water main there is provision to avoid shock, so, close up to an engine, there ought to be a reservoir out of which steam could expand to the cylinder and which should equalise the flow in the steam pipe. If such vessels were adopted the size of the steam main could be made less, and this might be done by enlarging the last length or so of pipe, if no room for a reservoir could be made near the cylinder. Without such reserve the flow of steam in a pipe must be most irregular and pulsating.

A receiver ought, says Mr. Cooper, to be 50 times the capacity of the cylinder up to cut-off, and a 1,250 H.P. engine can be run with a 6-inch steam pipe with only 3 lbs. loss of pressure in the transmission in a pipe 100 feet long. It is better to err in using pipes too small than too large, and a velocity of 200 feet per second can be allowed without making the drop of pressure uneconomical. It is not impossible that even a 300 feet velocity can be employed with suitable receivers and well-designed elbows to the pipe.

In steam practice there is a good deal of work to be done other than new designing. Thus, given an old engine and a new boiler to be coupled, then to reduce the steam pressure to that suitable for the engine, it would be desirable to do so by using very small pipe, keeping the boiler pressure to a maximum. It is well known that old and weak engines will work more economically from a high pressure boiler wiredrawn down than from unwiredrawn low pressure steam. Where, of late years, attention has been given to steam piping it has been wrongly applied, and gone almost wholly in the fanciful design of duplex mains, ring mains, and innumerable connecting valves arranged with a view of keeping any engine at work, no matter where some steam pipe failed. Now of all abortive efforts the ring main is one of the worst. With its many valves hot and cold on different sides, all apt to leak, with cool spots for water, many water hammer risks, bad drainage, counter currents, and what not, the ring main is simply an incentive to breakdown. A good lapwelded or solid drawn steam pipe will not fail. Why make a bad design of it and induce failure? We certainly trust to see less of the much-extolled ring main and more of simple mains of sound design and material, with a minimum of valves. Some stations must have spent a fortune in unnecessary pipes and valves in the fatuous strife for duplication—we had almost written duplicity.

## BALL BEARINGS.

A writer in *Engineering* speaks of the ball bearing fad and gets promptly corrected for arguing that ball bearings are wrong. It appears that his idea of ball bearings is that balls roll in circular grooves, for he speaks of balls sliding for considerable distances. People who doubt the ball bearing should endeavour to fix in their minds the fact that a properly constructed ball bearing is to be laid out on the lines of a cone bearing. Thus if O be the centre of revolution, draw O F, O E, at equal angles, cutting the ball at points *a*, *b*, *c*, *d*. Then will the cone, *a*, *b*, *c*, *d*, be the equivalent cone which would run truly on surfaces, F O and E O, and to get true rolling results with ball bearings instead of cones there must be drawn tangents to these four points, viz., the tangents, *h h*, *l l*, *m m*, *n n*. Then will these tangents represent the surfaces of the cones in which the ball will roll truly without grinding, the length of path rolled on being exactly proportioned to the spherical sections through the contact points. Thus the line, *a d*, bears the same ratio to the line, *b c*, as does the radius of revolution, O *a*, to the radius, O *b*. We have batched the lines showing the bearing cones to render our diagram more clear. The dimensions of the angle, $\phi$, relative to the ball determine the shape of the bearing surfaces. When O E and O F become tangents to the balls, these roll on one section only and would be extruded by the pressure. With a flat angle, $\phi$, the bearing cones become acute, as may at once be seen by a rough sketch. It is doubtful if the angle at the apex of the bearing cones, that is, between the tangents, *l l* and *h h*, should be less than 90°. At smaller angles the destructive effects of the balls is intensified, and the speed of rotation of the balls is much increased by reason of their rolling on a smaller circle. Even when used for rectilinearly moving pieces, we would prefer




the surfaces to be slightly coned in order to secure two bearing circles. Between two flat surfaces the balls can only run on one circle. Cones, however flat, give two paths on the ball, and only half the load on any one point. Balls must not run in a curved groove for then they grind all over their area of contact.

The narrowness of path in a ball bearing demands that pressures shall not be too heavy, and, for heavy machinery, cones and cylinders which substitute lines for points, secure a practical advantage, though if materials were quite unyielding, balls would touch on mathematical points, and would have exactly the same bearing surface as cylinders where theoretical area of contact is a line or the trace of a mathematical point, and, therefore, no greater than a point. The smallest amount of yield in materials of construction puts, however, quite a different complexion on affairs, and makes a cylinder bearing superior to a ball bearing where loads are heavy.

## SPECIFICATIONS FOR INSULATED WIRE FOR THE NAVY.*

Insulated wire supplies required for the ships of the United States navy are classed as (1) lighting wire; (2) bell wire; (3) cable. The following general specifications apply to all:—†

I. All layers of pure Pará rubber must contain at least 98 per cent. of pure Pará rubber; must be of uniform thickness, elastic, tough, and free from flaws and holes.

II. All layers of vulcanised rubber must contain not less than 40 per cent., nor more than 50 per cent., of pure Pará rubber; must be concentric, continuous, and free from flaws or holes; must have a smooth surface and circular section; and must be made to a diameter in the finished conductor that will be in exact conformity with the diameter as tabulated.

III. All layers of cotton tape must be fitted with a rubber insulating compound, the tape to be of the width best adapted to the diameter of that part of the conductor which is intended to bind. The tape must lap one-half its width and be so worked on as to insure a smooth surface and circular section of that part of the finished conductor which is beneath it.

IV. All exterior braid must be closely woven, and all, except silk braid, must be thoroughly saturated with an insulating waterproof compound which will neither be injuriously affected, nor have an injurious effect on the braid, at a temperature of 200° F. (dry heat), or at any stage of test, the conductor being sharply bent. Wherever a diameter over vulcanised rubber or outside braid is tabulated or specified, it is intended to secure a neat working fit in a standard rubber gasket of that diameter for the purpose of insuring watertightness of the joint, and no departure from such tabulated or specified diameter will be permitted.

Lighting wire is classed as single conductor and double conductor, and tables are given of standard dimensions. All conductors must be of soft annealed pure copper wire.

*Single Conductor.*—No single wire larger than No. 14 B. & S. gauge to be used. When greater conducting area is required, the conductor shall be stranded in a series of 7, 19, 37, or more wires, as required; the strand consisting of one central wire, the others laid around it concentrically, each layer to be twisted in the opposite direction from the preceding, and all single wires forming the strand must be

* New York *India-Rubber World*.

† According to regulations in force since March, 1897.

of the diameter given in the table adopted by the American Institute of Electrical Engineers in October, 1893. The measured conductivity of each single wire forming the strand shall not be less than 98 per cent. of that of pure copper of the same number of circular mils, the measured conductivity of the conductor as a whole to be not less than 95 per cent. of that of pure copper of the same number of circular mils. Each wire to be thoroughly and evenly tinned.

All lighting conductors to be insulated as follows:—1. A layer of pure Pará rubber, not less than $\frac{1}{64}$ inch in thickness taped or rolled on; if taped, the tape to lap one-half its width. 2. A layer of vulcanised rubber, of exact diameter as tabulated. 3. A layer of commercial cotton tape, lapped to about $\frac{1}{32}$ inch in thickness. 4. A close braid to be made of No. 20 two-ply cotton-thread, braided with three ends for all conductors under 60,000 circular mils, and of No. 16 three-ply cotton thread braided with four ends for all conductors of and above 60,000 circular mils. The outside diameter over the braid to be in exact conformity with that tabulated.

For tests two samples each 500 feet long will be chosen. After immersion 24 hours in sea-water they must have an insulation resistance of not less than 1,000 megohms per nautical mile. Test to be at 72° F. To be tested by the direct-deflection methods, at a potential of not less than 200 volts. Samples will be tested for a conductivity of not less than 95 per cent. of that of pure copper, having a cross-section of the specified number of circular mils. Chemical tests will be made to determine the constituents of the different layers of the insulation. Braid will be tested for water-proof qualities. Physical tests will be first made for qualities of strength, toughness, dimensions, &c. Physical and electrical characteristics of the insulation under change of temperature will be tested by exposing the finished conductor for several hours at a time alternately, to a temperature of 200° F. (dry heat) and the temperature of the atmosphere, during a period of three days. Tests for characteristics of the insulation will then be repeated and must show no practical deterioration on the results of the former test.

*Double Conductor.*—Classed as (1) plain; (2) silk; (3) diving-lamp. The plain to be constructed as follows: A copper conductor of seven No. 22 B. & S. gauge, tinned, annealed, pure copper wires, six of the wires to lay around the seventh. Each single wire to have a measured conductivity of not less than 98 per cent., and the conductor as a whole of not less than 95 per cent. of that of pure copper of the same number of circular mils. One conductor is to be laid with (1) a layer of vulcanised rubber to an external diameter of 0·181 inch; (2) with a close braid of No. 60 cotton thread, braided with three ends. This conductor will form the core, and the wires of the second conductor will be laid around it over the braid concentrically and smoothly. Over both conductors will be: (1) A close braid of No. 60 cotton thread, braided with three ends; (2) a layer of rubber vulcanised before braiding, of an external diameter of $\frac{11}{16}$-inch; (3) a layer of commercial cotton tape, about $\frac{1}{32}$-inch thick; (4) a close braid of No. 30 three-ply linen gilling thread braided with two ends; (5) a close braid of No. 30 three-ply linen gilling thread braided with three ends. The fourth and fifth layers of braid to be thoroughly saturated with a water-excluding compound which will not injure the braid or render the conductor less pliable.

Similar but not precisely identical specifications are given for "double conductor, silk" and "double conductor, diving lamp" wire. In tests, double-conductor wire, plain, and the diving-lamp wire shall have an insulation resistance between conductors and from each conductor to ground of at least 1,000 megohms per 1,000 feet after the 24 hours immersion in sea-water at 72° F. This insulation must also exist after the whole length has been exposed for four hours to a temperature of 180° F. Double conductor, silk, should have an insulation resistance between conductors of at least 20 megohms per 1,000 feet, tested in air at a temperature of 72° F.

*Bell Wire.*—Classed as (1) bell wire, and (2) bell cord. The first to be a copper conductor consisting of one B. & S. gauge, No. 16, tinned, annealed copper wire whose measured conductivity shall not be less than 98 per cent. of that of pure copper of the same number of circular mils; a layer of pure Pará rubber, taped or rolled on to a thickness of not less than $\frac{1}{64}$th inch, and if taped, the tape to lap one-half its width; a layer of vulcanised rubber to a diameter of 0·1425 inch; a layer of commercial cotton tape, about $\frac{1}{32}$ inch thick; a close braid of No. 40 two-ply cotton thread, braided with three ends. Bell cord is classed as double and triple, with specifications similar to the above.

*Cable.*—Classed (1) controller cable; (2) interior communication cable; (3) whistle cable; (4) special cable. Controller cable to consist of 19 No. 22 B. & S. gauge, tinned, annealed, pure copper wires, concentrically stranded; each single wire to have a measured conductivity of not less than 98 per cent., and the conductor, as a whole, not less than 95 per cent. of that of pure copper of the same number of circular mils; a layer of pure Pará rubber taped or rolled on to a thickness of not less than $\frac{1}{64}$ inch; a layer of vulcanised rubber to an external diameter of $\frac{9}{32}$ inch; seven conductors so constructed to be laid up or twisted together to a circular section, six conductors to lay around the seventh to an external diameter of $\frac{37}{64}$ inch; then to be covered with (1) a layer of vulcanised rubber to an external diameter of $\frac{13}{32}$ inch; (2) a layer of commercial cotton tape about $\frac{1}{32}$ inch thick; (3) a close braid of No. 30 three-ply linen gilling thread, braided with three ends; (4) a close braid of No. 30 three-ply linen gilling thread, braided with four ends, to a finished diameter of 1¼ inches. Controller cable to be furnished in lengths of 25 feet, to be fitted at each end with a thoroughly tight male coupling made to conform to the design approved by the department. Such cable must show an insulation resistance between conductors and from each conductor to ground of not less than one megohm after immersion in sea-water at a temperature of 72° F. for 24 hours.

Space will be given here for one more specification—that for special cable for range-finding, included under the head of whistle cable:

The conductors shall consist of three 22,799-circular-mils standard lighting wires and one standard bell wire, except that they shall not be covered with tape or braid. The four wires so constructed shall be laid or twisted together with jute laterals, saturated with an insulating compound, to a circular section and an external diameter of $\frac{25}{32}$ inch, the three large conductors to lay around the bell wire. Then to be covered with (1) a layer of commercial cotton tape about $\frac{1}{32}$ inch thick; (2) a layer of vulcanised rubber to an external diameter of $1\frac{1}{16}$ inches; (3) a close braid of No. 16 two-ply cotton thread to a finished diameter of 1½ inches.

## TRUE HEATING SURFACES.

A paper on "Heating Surface" is novel, despite the fact that heating surface is so important a factor. Mr. C. W. Baker read such a paper before the American Society of Mechanical Engineers at Niagara. He remarks that there is a common error of 7 to 17 per cent. made by many engineers in computing such surface. They measure the surface which is in contact with the water. This can only give correct results when the surface is flat.

Tubular surface differs about 17 per cent. for 1-inch tube and 7 per cent. for 4-inch tubes according as the surface is measured inside or outside. The resistance to the passage of heat is three-fold. There is the resistance at the heat receiving surface to the entry of heat, the resistance of the body of a plate to the travel of the heat through its mass, and the exit resistance on the water side. The second alone is known; in practice it may be assumed that it is negligible, the conductivity being such that heat passes through a plate with very little resistance, and this disposes of any fancied superiority of brass or copper above iron or steel.

Experiments have shown that the most intense heat fails to melt a fusible plug in a metal plate with water in contact with one side of it. The author describes as something surprising an experiment which showed that a 2-inch tube surrounded by cold water and heated by a large oil lamp, was able to condense on its surface the steam from the gases, and did so until the surrounding water became heated to 60°. It is a well recognised fact that the lower foot or so of the Green's economiser does the same thing if fed with cold water. In brief, Mr. Baker argues that the water side is so efficient that it can deal with all the heat that can possibly be sent to it. It is the fireside that is least efficient, and therefore heating surface must always be measured on the fireside. To promote efficiency it is obvious there is sound sense in the Serve method of radial ribs inside fire tubes. Similarly a plate covered by projecting pegs will be more efficient than a plain surface. The legged pot of the gipsy is a case in point, and all such projections are so much heat absorbing surface. They carry the heat into the plate. The plate is well able to deal with all that can be taken into it. If a plate be made with long projections, these will gradually burn away to a certain minimum. Below that they will not waste. They will continue to waste until they have become just so short that their exposed area only supplies so much heat as their cross-sectional area can carry off. All superfluous projecting length is burned off. So far as heat transmitting efficiency is concerned, the author makes light of the question of water circulation.

It does not affect evaporation, however important to the boiler structure. Cleanliness of the fireside from soot or dust is therefore far more important than waterside cleanliness, and the old idea that a thin coat of scale is of serious importance may be thrown aside. Indeed, it is pretty certain that if scale were so very important, the formation of steam would soon take place between scale and plate, and the scale would be speedily detached thereby. The author maintains that boiler heating surface ought to be computed therefore on the fireside area and not on the waterside. This, of course, gives an advantage to water-tube boilers, an advantage to which they are fairly entitled, and against which the makers of the fire-tube boilers must set the better cleansing of fire tubes which is possible.

At the same time we would caution steam users against too much reliance on cooling surface. Much depends upon the water. With soda in solution the cooling effect of water is much reduced. Water at all thickened is liable to stand clear of the plates, and heat transmission is greatly retarded by such conditions.

## NOTES ON BELTING.

Mr. Flather, an American authority on belting, gives the following formulæ for cemented and laced belts: $b = c\frac{H\,P}{v}$, where $b$ is the breadth in inches of the belt, and v is the velocity in feet per minute, c being a coefficient as follows:—

| | Cement joint. | Laced joint. |
|---|---|---|
| Single belt ... ... ... | 800 | 1,050 |
| Double „ ... ... ... | $\frac{800}{2}$ | $\frac{1,050}{2}$ |
| Triple „ ... ... ... | $\frac{800}{3}$ | $\frac{1,050}{3}$ |

The above values for c are larger than some authorities would give, but they are on the safe side, and save much annoyance from stoppages and for repairs. Double and triple belts are more used in America than in England, and when used the pulley diameter should be at least 100 times the belt thickness, or if less, some allowance should be made for the bending resistance.

The formula assumes an arc of contact of 180°, and the thickness of single belting as 0·20 inch, though it varies between 0·16 and 0·25. The coefficient, $c_1$, must be increased for double and triple belts when the pulleys are small, thus:

| Double belt pulleys. | Triple belt pulleys. | Value of $c_1$. |
|---|---|---|
| 8 inches diam. | 18 inches diam. | 1·40 |
| 12 " " | 26 " " | 1·25 |
| 20 " " | 42 " " | 1·10 |

Again for arc of contact less than 180° the coeficient must be varied. This has been determined for different arcs from 120° to 240° as in the following table:—

| Arc. | Value of $c_2$. |
|---|---|
| 120° | 1·33 |
| 130° | 1·27 |
| 140° | 1·21 |
| 150° | 1·15 |
| 160° | 1·10 |
| 170° | 1·05 |
| 180° | 1·00 |
| 190° | ·95 |
| 200° | ·91 |
| 210° | ·87 |
| 220° | ·83 |
| 230° | ·79 |
| 240° | ·75 |

The benefit of large arc makes it desirable that the bottom side of a belt should be the driving side, so that the top side when sagging may increase the arc of contact. Centrifugal force need not be considered up to speeds of 2,500 feet per minute.

Where centrifugal force has to be taken into account, a third coefficient, $c_3$, is required to correct for this force. The formula for belt width now becomes $b = c\, c_1\, c_2\, c_3 \frac{H\,P}{V}$.

The values of $c_3$ are given in the following table:—

| Velocity. | Cemented belt. | Laced belt. |
|---|---|---|
| 2,500 | 1·06 | 1·10 |
| 3,000 | 1·10 | 1·14 |
| 3,500 | 1·14 | 1·20 |
| 4,000 | 1·19 | 1·27 |
| 4,500 | 1·26 | 1·37 |
| 5,000 | 1·34 | 1·50 |
| 5,500 | 1·44 | 1·65 |
| 6,000 | 1·58 | 1·87 |

In determining centrifugal force, the weight of a foot length of belt 1 square inch cross-sectional area is taken as 0·41 lb.

One of the examples given and worked out is for the case of a double belt to transmit 175 H.P. at 3,180 feet on pulleys of 90 and 60 inches diameter. Assuming cemented joints $c$ is $\frac{800}{2}$, $c_3$ may be taken at 1·05 for an angle of 170°, and $c_3$ as 1·11. The result is 24 inches. A belt of 19½ inches was actually employed. For laced belts the maximum horse-power is obtained at a speed of 5,400 feet, beyond which centrifugal stress increases faster than the increase of speed strength. For cemented belts the maximum speed is 6,300 feet. As with ropes however, the increase of capacity for the last thousand feet of speed is not worth striving after very particularly if it demands extraordinary shaft speeds and pulley diameters. For belts apart from other considerations, anything between half and three-fourths the speed of maximum efficiency will give good results.

## PARIS SMOKE PREVENTION ORDINANCE.

The following notice regarding smoke prevention has been issued in Paris:—

Paris, *June 22nd*, 1898.

We, the Prefect of Police:—

In accordance with the law of August 16th-24th, 1790; the Government Decree of the 12th Messidor, year 8; Articles 471 and 474 of the Penal Code.

In accordance, moreover, with the reports of the Council of Public Health and Salubrity of the Department of the Seine, dated June 15th, 1898, and April 1st, 1898. Together with the report of the Technical Commission instituted by the Prefect of the Seine, for the arrangement of an open competition on March 19th, 1894, by the Municipal Council of Paris, between the various inventors of smoke-consuming systems.

In accordance with the observations submitted to the Municipal Council of Paris, in the name of the Second Commission, June 21st, 1898.

Considering that the increasing number of furnaces burning large quantities of fuel has considerably added to the inconveniences arising from smoke in Paris.

That this smoke obscures the air, penetrates into dwelling houses, blackens and injures the exterior of houses and public monuments, and infects the atmosphere of the city.

Considering that there are in existence various practical and effectual methods of lessening the nuisance as far as possible.

That manufacturers can have recourse, in particular to increasing the height of the chimney, to using a suitable kind of fuel or to the employment of smoke-consuming furnaces.

We issue the following decree:—

Article 1. After six months from the date of this decree, it will be forbidden to produce black, thick, and continuous smoke, that can reach the neighbouring dwelling houses, or infect the atmosphere of Paris.

Article 2. Contraventions of this decree are to be notified by reports which will be laid before competent tribunals.

Article 3. The chief inspector of the technical service of classified establishments, and the inspectors placed under his orders, and also the mining engineers appointed for the supervision of boilers, and the agents placed under their orders are charged to ensure compliance with this decree, which will be printed, published, and posted up.

The Prefect of Police,
Charles Blanc.

By the Prefect of Police,
The Secretary General,
E. Laurent.

## THE TELEPHONE COMMITTEE'S REPORT.

(*Continued from page* 291.)

Before your present Committee Mr. Forbes took up a different position.

(Q.) 5,687. "But they [the Post Office] reserved it [their discretion], according to you, under a verbal pledge not to exercise the power which they so deliberately reserved?—(A.) Well, they reserved their discretion; but they reserved their discretion in a positive promise that that discretion should only be exercised in each case under certain circumstances; they have got their discretion now; if they choose to begin to-morrow in any town they can begin; if they choose to license anybody they can; but if they did license, or if they did begin, they would be breaking the pledges made to me by Mr. Goschen, by the Postmaster-General, and by others as to the circumstances under which that exercise of discretion should be put into operation."

This evidence, however, he subsequently modified, as follows:—(Q.) 6,469. "But did Mr. Goschen in any way in this private negotiation lock up his discretion?—(A.) Not in the slightest. (Q.) 6,470. Then what did he do?—(A.) He simply said the conditions of the Treasury minute will be applied with discretion, and that sort of thing. I put to him, What interpretation am I to attach to this? Well, you are to co-operate, you are to do what you can to carry out the desire of the Government, which is to get possession of the trunk wires, to greatly improve the trunk service of the country, and to develop its telephone system both in local areas and from one area to another as rapidly and as efficiently as possible; you are to co-operate in that; we are both in the same boat, so to speak, in desiring to do this: you can help us, we can help you; words almost of that kind. (Q.) 6,482. Did ever he give any promise whatever that he would exercise this discretion in any particular manner?—(A.) Not beyond that, that we should be treated with all proper consideration. I believe that was the very last word he said to me at the end of the discussion, you will be treated with proper consideration: and that we really had to make this property a success. (Q.) 6,483. It is on those words you rely to be protected against competition?—(A.) I do. (Q.) 6,484. And those only?—(A.) And those only."

Mr. Goschen, who was Chancellor of the Exchequer in 1892, when the Heads of Agreement were arranged and initialled, gave this evidence before us: (Q.) 7,228. "I should like to put the same question to you as I put to Mr. Forbes. Would the granting by the Post Office of a license to a municipality now be, in your opinion, an evasion of the spirit of the agreement entered into with the National Telephone Company?—(A.) I cannot think that it would; I think there are words which distinctly contemplate it in the very speech to which attention is called."

Sir J. Fergusson, who was Postmaster-General, and initialled the Heads of Agreement in 1892, gave the following evidence on the subject of competition: (Q.) 2,244. "You are quite convinced that there was no sort of undertaking come to of any sort?—(A.) I am quite convinced; on the contrary, when you come to talk of an 'undertaking,' I gave the strongest refusal to entertain it at all, because I said that neither the Government nor the House of Commons would listen to any undertaking of the kind."

Mr. Arnold Morley, who was Postmaster-General from 1892—1895, stated that he had never heard of any such understanding as that alleged by Mr. Forbes.

The two remarkable letters, dated respectively February 9th and March 13th, 1893, which your Committee saw for the first time at their last meeting for taking evidence, placed beyond doubt the entire absence of any limitation, whether by verbal understanding or otherwise, upon the unrestricted right of the Post Office to allow the fullest competition.

The plea of verbal understandings being thus disposed of, we may now cite the actual documents.

Clause 19 of the Treasury minute of May 23rd, 1892, states that—

"As to fresh licenses, no further license for the whole country will be granted; and even for a license to establish an exchange in a particular town no application will be entertained unless a formal resolution in its favour has been passed by the Corporation or other

municipal authority, and evidence given that there is sufficient capital subscribed to carry out the undertaking. In this way competition will not be excluded, but a check will be imposed on the formation of companies whose sole object it is to force the existing licensees to buy them up.

"But although this is the policy which commends itself to Her Majesty's Government, it must be distinctly understood that, should licenses hereafter be granted on other principles, no company, now or hereafter to be licensed, will have any ground to complain of breach of contract, or want of good faith, on the part of the Postmaster-General."

The Heads of Arrangement between the Postmaster-General and the National Telephone Company, Limited, dated August 11th, 1892, contain the following Clause 2 (3):—

"The license to be for the residue, still unexpired, of the term of years specified in the present license held by the National Company, and to contain all the provisions contained in such license (including the provisions for determining such license and purchasing the business of the company) so far as such provisions are not inconsistent with these Heads of Arrangement."

The License of the National Telephone Company, Limited, dated November 29th, 1884, stated in Clause 19:—

"Nothing in these presents contained shall prejudice or affect the right of the Postmaster-General from time to time to establish, extend, maintain, and work any system or systems of telegraphic* communication (whether of a like nature to the aforesaid business of the company or otherwise) in such manner as he shall in his discretion think fit, neither shall anything herein contained prejudice or affect the right of the Postmaster-General from time to time to enter into agreements for, or to grant licenses relative to the working and user of telegraphs (whether of a like nature to the aforesaid business of the company or otherwise) or the transmission of telegrams in any part of the United Kingdom with or to any company, person or persons whomsoever, upon such terms as he shall in his discretion think fit."

The Draft Agreement of August 7th, 1894, and the Agreement of March 25th, 1896, between the Postmaster-General and the National Telephone Company, Limited, contain the following clause:—

"Nothing in these presents contained shall prejudice or affect the right of the Postmaster-General from time to time to establish, extend, maintain, and work any system or systems of telegraphic communication (whether of a like nature to the aforesaid business of the company or otherwise), in such manner as he shall in his discretion think fit, neither shall anything herein contained prejudice or affect the right of the Postmaster-General from time to time to enter into agreements for or to grant licenses relative to the working and user of telegraphs (whether of a like nature to those worked and used by the company or otherwise), or the transmission of telegrams in any part of the United Kingdom with or to any company, person, or persons whomsoever upon such terms, and whether with or without authority to exercise the powers in Section 5 of the Telegraph Act, 1892, referred to, as he shall in his discretion think fit."

## III.

The right to compete being thus made clear, we had next to consider whether competition was expedient, and if so, whether local authorities should be empowered to undertake a telephone service.

Competition appears to be both expedient and necessary, in order, firstly to extend and popularise the service, and next to avoid a danger which is by no means remote, if no alternative system is in operation, that a purchase of the company's undertaking at an inflated price may be forced upon the Government of the day.

Competition by a local authority must differ in many ways from competition by a private company, and requires special provision to meet the special conditions of the case.

In areas where the company have already an exchange, municipal competition, if permitted, should be conducted, so far as possible, on equal terms. It would be plainly unfair to concede the new licensee a position of general advantage over that possessed by the older competitor.

The peculiar advantages, however, already possessed by the company themselves constitute the principal difficulty in the way of formulating such an equality of treatment. The duration of its license, the power to give preferential rates (a power which, when excercised by the predecessor of the company, is alleged to have driven the Post Office from the field at Plymouth), the absence of a maximum rate, the power to refuse service, and the consequent power to require concessions of overhead wayleaves, its numerous exchanges, and the power to make other areas pay for reduced rates in areas where competition exists—these are advantages which together outbalance the special advantage which would be possessed by a local authority as licensee, the right to give to itself and refuse to its rival permission to lay wires under its own public streets.

A local authority must also submit to conditions to which the company is not subjected.

Among these conditions are the following:—

1. The system (unlike that of the company) must be one of double wires, and be erected in accordance with the regulations of the Post Office. The Post Office should insist upon uniformity of system, so far as the differing conditions of different localities may permit.

2. A maximum rate should be imposed, and no opportunity be afforded to local authorities to carry on the service with a view to lighten the burden of local taxation.

3. It must give a service to all alike on equal terms.

A royalty should be paid to the Post Office, which should be 10 per cent. on the gross receipts, and be the same in all respects as that paid by the company.

* It has been decided by the Courts that "telegraph" includes "telephones."

Although there appears no reason in equity why a new licensee should not be conceded a term equal to that originally conceded to the company, there may be reasons of public convenience why all licenses alike should lapse to the Post Office at the same date.

Where two systems compete in the same area, the first in the field has a further advantage. But your Committee believe that, the areas being so large, in every area large sources of supply remain untapped. Under a more popular scheme of service this supply may be very considerable. The company is itself in vigorous competition in various areas with its licensor the Post Office, which in almost every case was the first to occupy the ground. While the profits of the company in such areas are probably large, it is satisfactory to learn that, in spite of the hampering restraints till lately imposed by the Treasury, and of the necessity a public body is under to give no preferences, the local profits of the Department have not been inconsiderable.

A difficulty arises in holding the balance equally between the local authority and the company from the fact that while it seems generally admitted to be desirable in the public interest that all licenses should terminate in 1911, it is not possible to secure this, and at the same time leave to the local authorities adequate time to recoup themselves for their outlay.

The opinion has been strongly urged that as between the company and the local authorities the most equitable course would be that the Post Office in licensing a local authority, should undertake to buy its plant, at a fair valuation, in 1911, if the license were terminated at that date, but that owing to the length of time which the company has had for recouping its outlay, it is not necessary to apply the same condition to it.

It has also been urged that it would be unfair to the company that the Post Office should agree to purchase the property of the local authority, and remain in the future, as it is now, under no obligation to purchase that of the company in the same area.

It would be unjust to the taxpayer that the Post Office should undertake to purchase in 1911 two sets of plant and buildings, which might be to a great extent superfluous.

While, however, a portion of the plant and buildings of the two competitors may be superfluous or obsolete in 1911, much will probably be found useful and as good as the Post Office could purchase elsewhere.

On the whole, your Committee think it would be fair as between its competing licenses that the Post Office should agree to take off their hands, in 1911, at the then value, without any compensation for goodwill for future profits, so much of the plant and buildings as it might consider suitable for the actual requirements of its own local service. Should the total quantity so considered to be suitable exceed the amount necessary for such requirements, due regard should be had, in purchasing the quantity actually required, to the fact that the local authority had been allowed a shorter period of license than the company in which to recoup its expenditure.

At the same time your Committee are strongly of opinion that the Post Office should remain, as it is now, under no obligation to purchase any plant or buildings in any area where a local authority and the company are not in *bond fide* competition, or are not working together under the sanction of the Post Office.

In case, however, instead of competing, the corporation and the company should combine their operations, the greater part of both the plant and the buildings would in all probability be so suitable and so conveniently placed, as to justify the Post Office in agreeing to take over the whole upon clear conditions to be named beforehand.

Just as, in the event of competition, the company and the local authority would be placed, as we consider, on fairly equal terms, if the proposals we have made are carried out, so if the two systems are amalgamated, or a working agreement for connecting their respective subscribers everywhere be arrived at between them, there should be equality as regards preferences, the right to refuse service, and underground wayleaves. The company should surrender the two former rights, which no public body could exercise, and the municipality should allow the company to have equal underground wayleave facilities with itself for connecting its exchanges and subscribers. In order to avoid difficulties as to disturbance of the streets, these wayleave facilities should be afforded to both by the Postmaster-General under his statutory powers in the same way as underground facilities are at present afforded by him to the company between post offices and exchanges, and between two exchanges. The Post Office should in no case undertake to buy useless or antiquated plant or unnecessary buildings, but subject to that condition it might properly agree, at the time when such working agreement is concluded, to purchase at its then value, in 1911, the plant and buildings of the whole undertaking.

Having thus provided for equality of treatment so far as is possible, in the event of either competition or agreement, your Committee would leave the two parties to take which course they prefer, believing that much must depend on the size of the area, and the other special circumstances of different localities.

The peculiar conditions of the agreement with the company prevent the Government from laying trunk wires to connect the subscribers of different systems within one area. This renders it almost necessary that the whole of the company's telephone area should be worked by any local authority which is desirious of giving a service to its own ratepayers. The frequent cases in which a Corporation has obtained powers to supply gas, water, tramways, and electric light outside its own municipal boundary, afford adequate precedent for a similar telephone service, especially as the telephone service within an area must necessarily be a connected whole.

Your Committee would recommend that if licenses are to be granted to local authorities the precedent of the Electric Lighting Act of 1882 should be followed, and provisional orders, containing borrowing powers, should be made by the Post Office for the installation of a telephone service as they are now made by the Board of Trade where

wayleaves and other powers are required for electric lighting purposes.

From the point of view of local finance, your Committee are of opinion that a telephone service would be as successful as has been the supply of gas, water, tramways and electric light by local authorities. Much, of course, depends in this case as in those upon the cost of constructing the service, and in all cases the local authority is perhaps the best judge of what is likely to be successful or not. It seems clear to your Committee that a local authority should be able to construct a system at a price below that which from various causes the company have spent upon theirs, and this opinion is confirmed by the fact that the probable cost of such a service in the hands of the Glasgow Corporation is based not upon estimates alone but on tenders actually received.

So far, therefore, as the legal or equitable rights of the company, or the financial or other interests of the locality are concerned, your Committee see no reason why licenses should not be granted to local authorities.

Although, as stated in evidence by Mr. Gaine, 95 per cent. of the telephonic messages are local, yet a local telephone service must differ in some important respects from a local service for supplying gas, water, or electric light. It is not like them, purely local and isolated, but it forms part of a national system, the general efficiency of which largely depends upon its uniformity and the equal facilities afforded for communication everywhere. The Council of the Association of Municipal Corporations by a small majority, and a conference of representatives of London local authorities unanimously, preferred the competition of the Post Office to that of local authorities. At the meeting of the Council of the Association of Municipal Corporations there were no representatives of Scotch municipalities, the two largest of which have applied for licenses.

A more general competition than the local authorities appear likely to undertake is a necessity because:—

1. Individual traders and others have a right to object to the service of a public necessity becoming a private monopoly where the monopolist has the power to distinguish between competitors in the same trade and the same district, a result which is not possible when the service is in public hands.

2. A service so important to the trade of the country should not depend on the present precarious wayleave rights of the company; and the necessary general wayleave powers over the whole country can only be entrusted to a public Department.

3. The taxpayers have a right to be protected against purchasing as a monopoly a system which was never intended to become such, and as to which the most complete rights of competition were reserved; and more especially against being placed in a position in which they may be forced to purchase such a monopoly at a price still further inflated by the necessity of immediate purchase.

On reviewing the whole of the evidence, your Committee is strongly of opinion that general, immediate, and effective competition by either the Post Office or the local authority is necessary, and consider that a really efficient Post Office service affords the best means for securing such competition. We further consider that when in an existing area in which there is an exchange, the local authority demands a competing service, the Post Office ought either to start an efficient telephone system itself, or grant a license to the local authority to do so.

With regard to areas in which there is no exchange, and districts which are not areas, we think some provision should be made beyond what is now offered by the National Telephone Company for giving a service when there is a reasonable local demand. In such cases the Post Office should either start a service of its own, or should grant licenses to the local authorities to do so, subject to proper regulations.

Your Committee, in thus recommending a Post Office service, assume that it will constitute a real and active competition, and that concessions to the company not required by the agreement will cease. Such a competition should, in their opinion, be carried on by a distinct and separate branch of the Department, and in future be conducted under strictly businesslike conditions, and by a staff specially qualified for such a duty.

*August 9th*, 1898.

## REVIEWS.

*Electricity and Magnetism.* By Francis E. Nipher, A.M., Professor of Physics and in charge of Electrical Engineering in Washington University, St. Louis, Mo.

The rate of publication of educational works on electricity and magnetism in recent years is clearly out of proportion to the progress of human knowledge of the parts of the subject they deal with. The explanation of this lies, no doubt, in the temptation to a teacher to print the subject matter of his normal course of lectures, thereby placing in the hands of his pupils material assistance in following his teaching, and economising his own labour. The certainty of a purchasing public in the members of his class removes any difficulty with a publisher. The constant increase in the numbers of students and teachers of physics produces continual additions to the list of such text-books.

The second edition of a text-book on electricity and magnetism by Prof. Nipher, of Washington University, has been sent to us for review. It is described as a mathematical treatise for advanced undergraduate students, and we presume it deals with the subject so far as it is required for the honour degree of that university. It is not likely that an American class text-book can have any considerable sale in this country, and it is more interesting to consider it as an indication of the state of science teaching in America, than as a possible investment for an English student. The work appears to us to be that of a sound mathematician and an indifferent physicist. The bulk of the book is occupied with the usual well-known and elementary theorems in attractions and kinetics, treated in the most academic fashion on the assumption of action at a distance; and assuming that the science course of Washington University includes a course of mechanics, the space given to this part of the subject is quite out of proportion to its importance. It is, of course, the part that naturally attracts the mind of a deductive logician, and repels the speculative physicist intent on the material secret hidden in the expressions. To deduce the whole body of facts of a complicated science from a small number of well-defined laws and definitions has been the aim of many educational writers. To us it seems clear that in the case of a science teeming with new experimental data this method is a waste of time, and a work on these lines cannot fairly be described as a treatise of the subject. Several subjects lend themselves to this kind of treatment for educational purposes. In its present stage electricity does not. At the same time Prof. Nipher's numerical examples of such quantities as the energy due to the attractions of the earth or moon, the comparative values of gravitational and electrical forces, the capacities and potentials of electrical bodies, redeem his treatment from the altogether commonplace.

Among this very sound, if unoriginal, matter there are some singular mistakes and omissions. The explanation of the fictive layer on page 96 reveals a complete misconception; the first problem of Chapter XII. neglects the changes mutually effected in the capacity of the spheres by one another's presence. Ohm's law is omitted altogether, as, indeed, are all references to the physical properties of matter excepting the jejune account of the magnetisation of iron. The description of the work as a mathematical treatise hardly prepares us for this severity of limitation.

The account of the two systems of electrical units, their mode of derivation, the relations between them, and the effect of suppressing the dimensions of permeability in one system, and of sp. ind. cap. in the other, is extremely well done; but here, when we leave the region of inductive reasoning from definition, and look for some account of the physical meaning of the common ratio of all these pairs of units, none is given. We suppose the explanation forms part of Prof. Nipher's post-graduate course, and are discontented. It may well be that he deliberately and severely confines his pupils to those parts of the subject which least encourage looseness of thought. We think his lectures may be a little dry.

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*The Law of Electric Lighting.* By J. Shiress Will, Q.C. London: Butterworth & Co. 1898.

Probably no member of the Parliamentary bar has a wider or more varied experience of the many points whereat electricity is rapidly touching our modern social life than the learned author of this treatise. His former work on "The Law Relating to Gas, Water, and Electric Lighting," is well known to the legal profession as one of the leading text-books on these subjects. The present volume is restricted to electric lighting, and is a compendious summary of the whole law bearing upon the subject.

The introduction, which fills some 35 pages, is a well considered synopsis of the various statutes, all of which were passed between 1882 and 1888, and there is little doubt that a study of this will be of material value to those who wish to master the complicated provisions of the statutes themselves.

By the Act of 1882, the Board of Trade was authorised to grant "licenses" to any person or body corporate to supply electricity for public or private purposes; but, as Mr. Will points out, licenses, as a rule, only lasted at the maximum for seven years, subject under certain conditions to renewal. This was evidently intended for the period of electric experiment, and licenses are now rarely applied for.

Their place has been taken by provisional orders, which may be applied for by persons, companies, or local authorities.

In dealing with the statutes, the author has pursued the plan of commenting on each section or sub-section, apart from the act generally, having dealt with this in the introduction. Cases are also quoted under each section, and not by means of footnotes. The full text of the statutes is given as well as a form of provisional order. This is rather a formidable document, and we quite appreciate the author's statement in the preface that "only one form of provisional order is inserted." He has, however, in this one form inserted full particulars as to the alterations which will be required to suit other circumstances. A very good index is added, and there can be little doubt that the book will be of very great value to all those who are interested in the law, as it affects electric lighting.

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*Chemical Analysis, Qualitative and Quantitative.* By WILLIAM BRIGGS, M.A., and R. W. STEWART, D.Sc. London: W. B Clive, University Correspondence College Press, 13, Bookseller's Row, Strand, W.C.

Everyone who has tried to do practical work in science with no resources but his own, knows too well the difficulties which frequently crop up and which, though seemingly insuperable to him, may be cleared up in a minute or two by a teacher. This book is designed for students who have to work by themselves, and it is hoped that with very little preliminary ocular demonstration they will be able to work their way and teach themselves how to analyse a simple salt. Any intelligent and industrious person ought to succeed in acquiring this ability with this book at hand to help him, for the treatment adopted by the authors is somewhat liberal and does not bear upon the face of it the stamp of cram. It is one of the most recent additions to that library of books for students which the University Correspondence College is issuing. The matter appears to be clearly arranged and up to date. We have tested the instructions given in several instances in which doubt or difficulty might easily creep in, and found nothing wanting. This little book is somewhat larger than books of this kind usually are owing to the detailed explanations given, and we think it will prove very useful to that class of students for whom it has evidently been compiled.

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*Dizionario Technico in quattro lingue: Italiano, Tedesco, Francese, Inglese.* Milano: Ulrico Hoepli.

We have received from Sr. Ulrico Hoepli, of Milan, the first three out of a set of four volumes in course of publication by him as a dictionary of technical terms in four languages, Italian, French, German, and English. The equivalents in each of these languages of about 16,000 technical terms and phrases are printed in parallel columns, of which the first is arranged alphabetically. The matter appears to be practically identical in each of the four volumes, differing in that the first, or alphabetically-arranged, columns of the several volumes are those of the four different languages. By this means equivalents in the other three languages are readily found of a technical expression in any one of the four by using the proper volume. The plan is undoubtedly an excellent one, and considering the size of the books, which are little larger than pocket-books and in good type, is well carried out.

As a matter of fact, this is not a dictionary at all; it is merely a vocabulary, and the difficulty of constructing a work on these lines will be recognised by anyone who considers how often the exact form given even to a technical expression depends on its context. The English part of this book requires a good deal of editing, and some of the words used are quite new to us. Bossage is given as the English equivalent of the same French word; enrockment of enrochement. Guarnitura d'una caldaia is translated "garniture of a boiler," and similar expressions are common throughout. We notice "brut weight," "architector," "apothem," and école d'agronomie is amusingly rendered "agronomy's academy."

The volumes contain a very large collection of accurate equivalents, besides others, and, used with caution, would be valuable to a translator. The price, 4 lire per vol., is certainly not excessive.

## THE BEHAVIOUR OF A TRANSFORMER AT THE INSTANT OF SWITCHING ON.

By ALFRED HAY, B.Sc.

THE initial stages of any forced periodic disturbance are known to differ, sometimes very materially, from the ultimate steady state into which the disturbance settles down. Such is the case, for example, when an alternating E.M.F. is introduced into an inductive circuit. The first few waves of current are in general very different from the normal type of current wave after a strictly periodic state has been reached. It is true that by properly choosing the phase of the E.M.F. when the circuit is closed, the current may be made to assume its normal cycle of changes from the very first. But this is a very exceptional condition. In general, we shall have highly-distorted initial waves, the amount of distortion depending on the phase of the E.M.F. at the instant of closing the circuit.

In the mathematical treatment of this subject, the function which completely represents the current consists of two essentially different sets of terms. The first set involves pure harmonic functions, while the second contains negative exponentials. It is obvious that the latter terms become evanescent as time goes on. It is very usual in many text-books to ignore the initial stages of the disturbance entirely, and to consider merely the strictly cyclic state. This, of course, is quite justifiable, since it is only the latter state that is of real importance in most cases.

Nevertheless, there are cases—such as that of an alternate current transformer—in which the abnormal initial phenomena may become so pronounced as to demand very special attention. This question became one of considerable practical importance when Dr. Fleming read his now classical paper on "Experimental Researches on Alternate Current Transformers" before the Institution of Electrical Engineers in 1892. It has since then frequently been asserted that the insulation of a transformer is in danger of being broken down by the initial current-rush *at the instant of switching on.*

The present paper is concerned with this very problem. It will be convenient at the outset to give a brief historical *résumé* of the various articles dealing with this subject.

In April, 1888, Dr. Sumpner read a paper on "The Variation of the Coefficients of Induction" before the Physical Society*, in which he gave a graphical method of constructing the current curve in a circuit of variable permeability, and pointed out that if an alternating E.M.F. be introduced into such a circuit at the instant when it is passing through its zero value, the amplitude of the initial current wave may considerably exceed the normal amplitude.

In 1892 Dr. Fleming, in the paper alluded to above, gave an account of some interesting experiments on initial current-rushes in transformers. In the discussion on this paper, Mr. Mordey and others described a number of further experiments bearing on the same subject. All these experiments were of a purely statistical and qualitative nature, without any attempt at a detailed study of the phenomenon.

In 1894 the present writer published in the *Electrician* a series of articles on "Impulsive Current-Rushes in Inductive Circuits,† in which an account was given of some experiments on current-rushes in circuits of constant permeability, the actual shape of the current curves being given. Some curves relating to a transformer were also given, but no complete theory of the phenomenon was attempted.

### THEORY OF IMPULSIVE CURRENT-RUSHES IN TRANSFORMERS.

It is assumed that the magnetic qualities of the core, the details of the winding, and the shape of the impressed P.D. wave are known.

Let $b$ = instantaneous magnetic induction, in C.G.S lines per sq. cm.
$a$ = sectional area of iron in core (sq. cms).
$s$ = turns in primary coil.
$e$ = instantaneous impressed P.D., in volts.

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* See *Phil. Mag.* for June, 1888, p. 453.
† The *Electrician*, Vol. xxxiii.

Then, if we neglect the drop of potential due to the resistance of the coil, we have approximately

$$e = \frac{a\,s}{10^8} \cdot \frac{d\,b}{d\,t},$$

so that

$$b = \frac{10^8}{a\,s} \int e\,d\,t + \mathbf{B}_r \qquad (1)$$

where $\mathbf{B}_r$ stands for a constant depending on the initial circumstances of the case under consideration.

We shall for the present suppose that the secondary circuit is open. The error involved in the assumption that the drop due to resistance is negligible is not serious, for under ordinary circumstances, even in the case of the most violent current-rush, the peak of the initial current-wave is below the normal maximum of the full-load current, and with the latter the drop, even in comparatively small transformers, does not exceed 1 per cent. of the impressed P.D.

The greatest possible current-rush will obviously depend on the greatest possible value which $b$ is capable of assuming in equation (1), and will be obtained when $\int e\,d\,t$ and $\mathbf{B}_r$ are numerically at their maxima values, and are of the same sign. Now the greatest numerical value of $\mathbf{B}_r$ is the residual induction corresponding to the normal maximum value of $\mathbf{B}$; this latter is readily obtained by integrating the known P.D. curve. In order that $\mathbf{B}_r$ might be equal to this maximum residual induction, it is obvious that the current must, when the transformer was last used, have been switched off while it was diminishing *numerically*. This, then, is one of the conditions which must be fulfilled if, at the next time of switching on, the current-rush is to have its maximum value.

Considering next the term $\int e\,d\,t$, it is easy to see that this will be a periodic function, and that the mean distance of its graph above the time-axis will depend on the initial value of $e$. The greatest height above the time-axis corresponds to $e = 0$ initially. This gives us the second condition which is necessary for the production of the maximum current-rush, viz., that the switch must be closed at the zero value of the E.M.F.

Assuming the above two conditions to be fulfilled, we see by equation (1) that the maximum value of $b$ is

$$b_{\max.} = \frac{10^8}{a\,s} \times \text{area of P.D. half-wave} + \text{maximum residual induction.}$$

The latter quantity is determined by reference to the hysteresis loop for the normal maximum of magnetic induction. Having determined the greatest possible value of $b$, we refer to the $\mathbf{B} - \mathbf{H}$ curve, and from it obtain the corresponding value of $\mathbf{H}$. From this latter the maximum value of the current is readily obtained by taking into account the number of turns, $s$, in the primary coil and the mean length of the magnetic circuit. The peak of the initial current-wave is thus easily determined.

The above approximate method may be used to investigate the variation of the current-rush with changes in the instants of switching on and off.

The method is only approximate; for, in determining the maximum value of $b$, we have used the P.D. wave (which is known) in place of the counter E.M.F. wave (which is not known—at any rate to start with). We have, in fact, neglected dissipation of energy due to the resistance of the coil, hysteresis, and eddy currents. And although for the mere determination of the peak of the initial half-wave of current such dissipation of energy may in most cases be safely neglected, it is far otherwise when we come to consider the subsequent history of the abnormal waves and the manner in which they gradually settle down into the normal type.

Were the transformer entirely incapable of dissipating energy when worked on open secondary circuit, there would be no gradual transition from a distorted initial wave to a normal one consisting of equal positive and negative half-waves—the initial wave would persist throughout as the normal type. This is at once evident from equation (1), which shows that $b$ would in that case be a strictly periodic function from the commencement.

No real transformer can, of course, satisfy this condition, and on account of the dissipation of energy which must always take place, the counter E.M.F. differs from the P.D. At any given instant the former may be obtained from the latter by subtracting the product of the current into the resistance of the coil. Let us consider briefly what effect this will have on the value of $b$ in equation (1). Suppose the core to have initially the greatest residual induction corresponding to the normal maximum of $\mathbf{B}$, and let the circuit be closed when the P.D. passes through its zero value. Since the initial half-wave of current is abnormally large, it will produce an abnormally large drop due to resistance. Hence the initial half-wave of counter E.M.F. will be abnormally small. Consequently the highest value reached by $b$ will be somewhat less than that calculated by the approximate method. During a considerable portion of the next half-wave of P.D., the magnetising current will be opposed to the P.D., so that the drop will have to be *added* instead of subtracted; during this period the current will have a relatively large value. Again, when a reversal of current does take place, the greatest negative value reached by the current during the second half-wave will be small, on account of the rapidly increasing steepness of the hysteresis loop in this region. Hence the time integral of the drop to be subtracted from the second half-wave of P.D. will be very much less than that to be added, and in consequence the area of the second half-wave of counter E.M.F. will be greater than its normal area. As a result, the minimum value of $b$ reached at the end of the second counter E.M.F. half-wave will be less than its initial value $\mathbf{B}_r$.

The same process will be repeated during the next complete wave of counter E.M.F., the maximum and minimum values of $b$ being less than the corresponding values during the first wave. This will go on until complete equality of all the half-waves (of counter E.M.F., magnetic induction and current) has been reached, *i.e.*, until the normal type of wave has been obtained.

We thus see that the primary cause of the gradual transition from the initial to the normal type of wave is to be found in the inequality of the areas of consecutive positive and negative half-waves of counter E.M.F. This inequality is due to the dissipation of energy which must necessarily take place in the transformer.

It is a matter of considerable interest to investigate how the greatest possible current-rush varies with the normal maximum of $\mathbf{B}$ at which the transformer is worked. Let us define a "current-rush" as the ratio of the maximum value

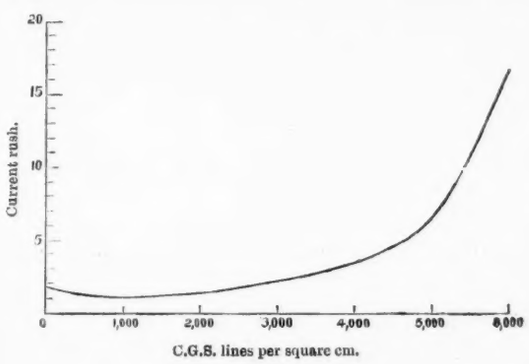


FIG. 1.

reached by $\mathbf{H}$ to its normal maximum. Applying the approximate method sketched out above to the data on page 74 of Prof. Ewing's *Magnetic Induction in Iron and Other Metals* for a certain sample of iron, and taking into consideration the values of $\mathbf{B}_r$ there given, we find the following set of values:—

| $\mathbf{B}$ = | 71 | 600 | 9·67 | 2,460 | 2,920 | 3,080 | 4,960 | 5,480 | 5,780 |
|---|---|---|---|---|---|---|---|---|---|
| Current-rush = | 1·66 | 1·45 | 1·45 | 2·1 | 2·35 | 2·48 | 5·72 | 9·7 | 13·5 |

These results are plotted in fig. 1. It is interesting to note the slight initial *decrease* in the current-rush for very low inductions. Beyond about 5,000 C.G.S. lines per sq. cm., the current-rush increases at an alarming rate. It must be remembered, however, that the values obtained by this approximate method are—especially in the case of the higher inductions—too high.

(*To be continued.*)

## SMOKE PREVENTION.

One way of looking on smoke prevention is the hopeful and philosophical one adopted by a contemporary, which in referring to the recent order made upon the Metropolitan Electric Supply Company to alter their plant to burn bituminous coal smokelessly, considers that the company will not after all be such great sufferers, for the capital outlay they will have to make will enable them to lower their future works' costs by burning cheaper fuel. This is all very well, but it seems to us that in a country like England, where the principal coals are bituminous, and where the principal steam-using practice is all based on bituminous coal, there has been something wrong in the engineering of many London stations when the absence of dear smokeless coal at once sends them into the police courts. It cannot be called good engineering which puts up furnaces suited only to the dearest coal.

A bituminous coal strike rarely cuts off every source of bituminous fuel, and still leaves the Welsh supply, but a Welsh strike cuts off all the smokeless coal. The fining of the electric light companies is not to be laid to their staffs, but to the folly and shortsightedness of their original designers.

Mr. Hannay, in recently inflicting a fine for smoke made by the above company, stated that since the Smoke Act had been left to the Vestries to administer, the subject had been neglected, and he had had only one case before him since 1891, the present case; but it was his experience that the nuisance could be kept within reasonable bounds by proper construction of furnaces and proper attention. Seeing that smokeless coal can be better burned in a bituminous furnace than in the haphazard furnaces considered good enough for smokeless coal, there is really no good reason why all furnaces should not be originally constructed on proper lines. Yet arguments are put forward in a way to mislead the uninitiated, to the effect that smokeless Welsh must needs have a special furnace built for it. If such were true, it would be hard on steam users to compel them to change to and fro according to the locality of each recurring coal strike.

But it is not so. One form of furnace will burn both coals equally well. True, it may not be necessary to admit so much or any secondary air above the fire with the less bituminous fuels, but this involves nothing more than the keeping shut of the air valves and proper regulation. It involves no structural alteration. The present trouble is to be laid to debit of consulting engineers, whose carelessness or inability has brought it about and done much to strengthen the hands of the strikers. In connection with this matter we would draw attention to an ordinance recently issued in Paris, which we publish on another page.

## NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

### NEW PATENTS.—1898.

*Compiled expressly for this journal by* W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

17,080. "Improvements in electrical transcribing apparatus." E. A. Hummel. Dated August 8th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, January 10th, 1898, being date of application in United States.)

17,113. "Improved means for automatically sounding electric alarms or the like." J. Werner and J. Dietz. Dated August 9th.

17,161. "Improvements in automatic switches and cut-offs." F. C. McMillin. Dated August 9th. (*Complete.*)

17,162. "An improved electric accumulator." L. Lejeune. Dated August 9th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, January 25th, 1898, being date of application in France.)

17,191. "An improved automatical contact breaker on electric railways and the like." J. C. Schafer and J. Lorintz. Dated August 9th. (*Complete.*)

17,193. "Improvements in the method of and means of drying the insulation of electric cables, armatures, bobbins, and the like." E. Passburg. Dated August 9th.

17,225. "Improvements in or relating to electric plug contacts." J. T. Niblett and M. Sutherland. Dated August 10th.

17,233. "Improved means or devices for attaching advertising tablets to electrical and other lamps, lamp-chimneys, or the like." H. M. Salmony. Dated August 10th.

17,253. "Improvements in electric telegraphs." W. Judd. Dated August 10th.

17,267. "Improvements in incandescent electric lamps and other electrical apparatus wherein glass bulbs or vessels are used." J. W. Swan. Dated August 10th.

17,268. "Improvements in secondary batteries or electrical accumulators." O. Behrend. Dated August 10th.

17,280. "Improvements in electrically-driven fans or ventilating devices." S. Bergmann. Dated August 10th. (*Complete.*)

17,345. "Improvements relating to electric bells." G. O. Lentschat. Dated August 11th.

17,354. "Improvements in electrically-propelled vehicles for common roads." C. Jeantaud. Dated August 11th.

17,358. "Automatic electric time switch." A. B. Webber. Dated August 11th.

17,359. "Improvements in electrodes for electrically obtaining ozone." D. Martini. Dated August 11th.

17,371. "An improved electric battery and bell combined." G. Markt. (Markt Bros. & Co., Germany.) Dated August 11th.

17,378. "Improvements in methods of electric haulage." G. Cawley and B. H. Thwaite. Dated August 12th.

17,380. "Improvements in drums for holding electric cables." T. Oxley. Dated August 12th. (*Complete.*)

17,390. "An improved clip and carrier combined for attaching to shades, globes, reflectors, and the like, and for attaching the same to electric incandescent lampholders." E. Duckenfield. Dated August 12th.

17,418. "Improvements in or relating to electric tumbler switch appliances and their base-plates." C. Markt. Dated August 12th.

17,451. "Improvements in electric current indicators." T. W. Varley. Dated August 13th.

17,458. "Improvements in primary electric batteries." A. A. Beadle. Dated August 13th.

17,488. "Improvements in electric secondary batteries." I. A. Timmis. Dated August 13th.

17,507. "Improvements in or relating to switch devices for electric tramways." E. Andreas. Dated August 13th.

17,522. "Improvements in means for transmitting motion from electric motors to other machinery." W. Geipel. Dated August 13th.

### ABSTRACTS OF PUBLISHED SPECIFICATIONS.

*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9*d.* (*in stamps*).

#### 1898.

7,384. "System of lever drawbridges with overhead conductors for electric railways." A. Clements. Dated March 23rd, 1898. Relates to the arrangement of the overhead conductors of electric railways on lever drawbridges. Two pairs of poles are erected on the piers of the bridge. The current conductor device arranged over the roadway on the bridge consists of two frames which are each formed of light T-iron conductors. Guy wires cross the beams. These beams turn in bearings on the poles, so as to permit the frames to be removed in a vertical plane. The trolley wire or overhead conductor on the roadway beyond the drawbridge is provided with a kind of frog at each end, which is suspended from the poles by means of guy wires for the purpose of anchoring the overhead conductor, when the bridge is closed the contact fork on the frame receives the frog so as to form an unbroken or continuous line of electrical conductors. 1 claim.

10,094. "Improvements in the art of making plates for electric battery purposes." A. C. Croftan. Dated May 2nd, 1898. Relates to certain improvements in the manufacture of spongy lead plates. The apparatus used consists of an air compressor, connected by means of a pipe, with a retort in the bottom of which are a series of small orifices. The retort is arranged above a suitable support, upon which is a receiving plate provided with a handle by means of which it can be moved about upon the support. The retort is supplied with lead which is melted by the application of heat, and an air pressure maintained in the retort by means of the compressor, sufficient to crowd the lead out through the orifices. The distance from the retort to the receiving plate is such that the metal as it falls reaches the receiving plate in a semi-solid form; that is to say, it is cooled down sufficently to prevent it from running together into a solid mass. Yet it is still in a sufficiently plastic condition to weld together as the particles pile up one upon the other. The plate thus obtained is comparatively light and exceedingly porous. 2 cl[illegible].

10,[illegible]. "Improvements in and relating to electric furnaces." T. Jackson. Dated May 4th, 1898. The furnace is provided with an inner shell composed of a compound of fire clay, round the five sides of which, and embedded therein, are wound five separate and distinct coils of platinum wire. The ends of these coils are connected to brass blocks, having intervening spaces formed between them to allow the insertion of plugs; a small brass strip at each end communicates the terminals with the blocks. The top of the outer case of the furnace is constructed of slate or other non-conducting material. 3 claims.

11,360. "Improvements in globe holders for enclosed electric arc lamps." K. Weinert. Dated May 18th, 1898. The globe employed is open at one end only where it is furnished with an outer fastening edge. On the lower frame plate are two opposite guides, in which by means of spiral springs, bearing pins are elastically suspended. On the lower end of the pins and sideways thereto, rollers are mounted to rotate, and above the rollers a projecting edge or border of suitable height is formed on the frame plate. 2 claims.